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So You're Switching to Turboprops

By CDR Richard A. Wigent

With some turboprop aircraft already in the fleet, it appears that more will be in widespread use shortly. P-3s, C-130s, and E-2s are already operational. Now that the OV-10, C-2 and other turboprop aircraft are coming on the scene, those that have been closely associated with jet and piston engines might well ask:

"Why the turboprop engine?

"What special advantages does it have?

"What are some of the problems encountered in transitioning to an airplane with this type of powerplant?"

This article will discuss these and other general questions that may be in the minds of those about to transition or be exposed to the operation of such aircraft for the first time. Most will be based on the fleet experience of the T56 since practically all of the Navy's turboprop aircraft use this engine.

Why The Turboprop?

The reciprocating engine, developing about one horsepower per pound of engine weight, has reached its limits of power output. To extend it further would mean unacceptable increases in size, weight and complexity—a case of diminishing returns.

Aircraft with large recip engines and constant speed props have been able to approach Mach 1. However, in this range and beyond, all propellers encounter an apparently insurmountable obstacle. The blade tips reach sonic speed before the aircraft. A variety of aerodynamic penalties are imposed such that it is practically impossible to obtain thrust for further acceleration—regardless of how much power an engine develops. Below Mach 1, however, the propeller is a near-ideal thrust converter.

Turbojet engines were developed because the jet-thrust reaction principle offered a means of overcoming the recip power limits. Capable of developing tremendous amounts of power, jet engines have demonstrated marked superiority in terms of altitude and high speed. However, the jet does not produce thrust efficiently at low altitude or low speed.

A turboprop engine combines the outstanding high power output of the jet engine with the very efficient thrust converting propeller. By marrying the two, the following advantages are realized:

- High power output—over two horsepower per pound of engine.
- Outstanding propulsive efficiency, particularly in the lower speed ranges, which provides excellent power response.
- Small cross-sectional and frontal area of the engine permits a light weight, low drag engine nacelle.
- Fuel economy by allowing the utilization of low cost jet fuels.
- Fewer controls and instruments to manipulate and monitor.

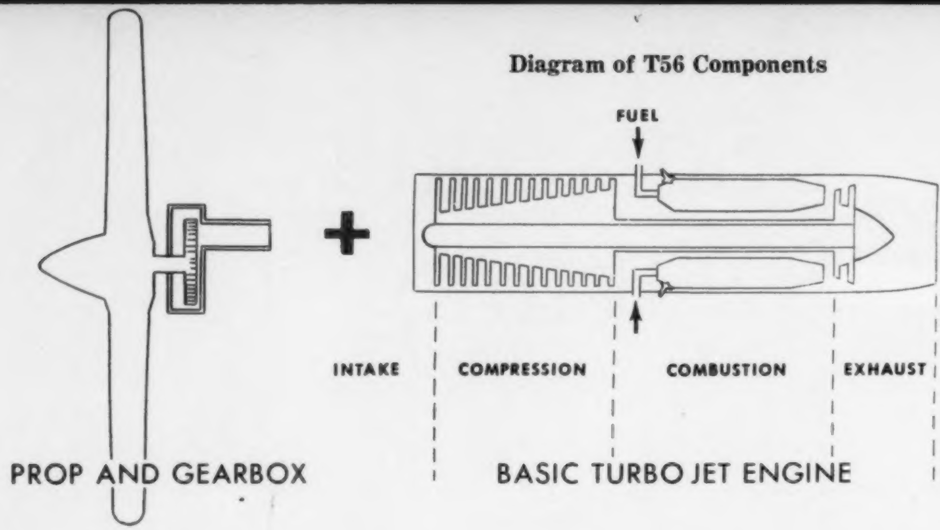
In short, it's a mighty fine engine. What about reliability? Currently in the mill is a proposal to increase flight time on some models of the T56 from 3000 to 4000 hours between overhauls. This speaks well of the engine—especially one that is relatively new in the fleet.

What Makes It Go?

Let's say that you are an engine manufacturer who is about to design a turboprop engine. How would you go about it? You'd probably start in the middle—the jet engine.

The type of jet engine you would use would depend upon your needs. Most turboprop engines use an

Diagram of T56 Components



axial flow jet engine since it has a slight edge in compressor efficiency. Spelled out to the pilot, this can mean a number of things: more miles per gallon, extra cargo, a slightly smaller engine for a given amount of power . . . .

Airesearch, however, chose a slightly different approach in designing the T76 for the OV-10. They chose a centrifugal flow compressor since it is somewhat less susceptible to foreign object damage. Considering the requirement of this aircraft to operate from rough, unprepared landing sites, the choice is logical.

Regardless of the compressor chosen, it has the purpose of providing large quantities of high pressure air to the combustion chambers.

In the combustion chamber, fuel is mixed with the air and ignited. Since pressure is constant throughout the burning process, then volume must increase—causing the hot gasses to force their way out the rear of the engine at an extremely high velocity. In short, the air is accelerated as it passes through the engine.

What was it Sir Isaac Newton said in his third law of motion? "For every *Action* there is a *Reaction*—opposite in direction and equal in force." Hence, the force of accelerating the air rearward creates an equal force forward. For the pure jet engine, this force or thrust is directly dependent upon the amount of air being processed by the engine and the acceleration imparted to it by the addition of fuel energy.

So what? This is still a long way from a turboprop. You're right—in fact, we really haven't even got a jet engine yet.

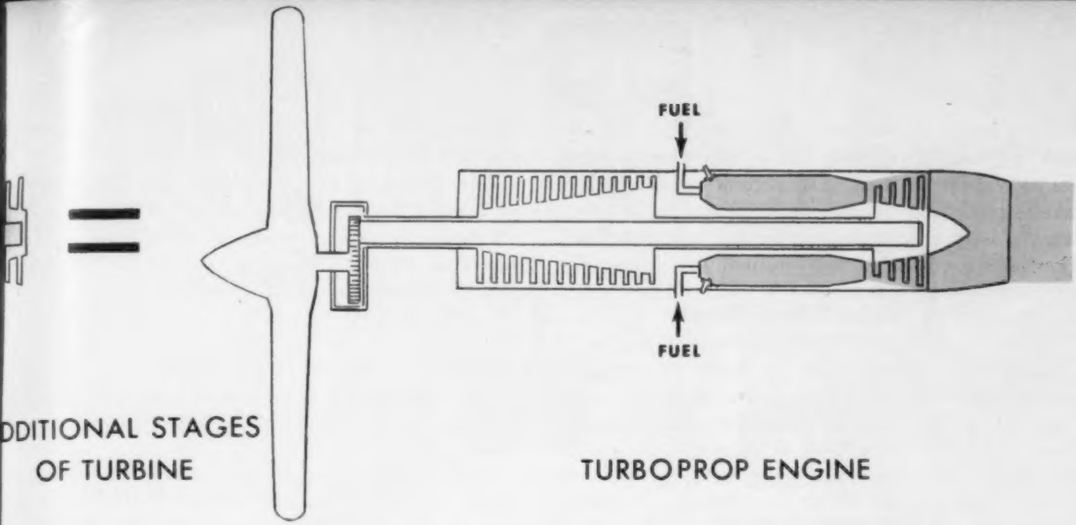
Let's turn our attention to the turbine. Here, the first change in converting a jet engine into a turboprop can be seen.

In a jet engine, one or more stages of turbines extract enough energy from the departing hot gases to produce shaft horsepower to run only the compressor and accessories (fuel, oil, and hydraulic pumps, generators, governors, for example). This is about 60-70 percent of the energy developed by the engine.

Turboprop engines, on the other hand, convert nearly all the energy into shaft horsepower. This power is utilized to drive not only the compressor and accessories but a propeller as well. Only a small percentage of hot gases is allowed to pass out the exhaust pipe as jet thrust—usually less than 10 percent. How? By additional stages or rows of turbine blades. The T56, for example, has four rows of turbine blades extracting over 10,000 shaft horsepower. About 60 percent of the power is used to drive the axial flow compressor. The remaining power is utilized by the propeller and its reduction gear box. Also, there still remains up to 750 pounds of thrust from the jet exhaust, roughly 7 percent of the maximum rated engine power.

Now let's see how the rotating shaft horsepower is transferred to the propeller.

It would be an easy matter just to extend the rotor shaft that attaches the compressor to the turbines, out the front of the engine and hook a prop on the end of it. But it's not quite that easy. Take the T56, for example. The compressor-turbine has optimum efficiency speed of 13,820 rpm. Obviously, if they were attached directly, the propeller blades would be well into the supersonic range from the high rotational speeds and would be quite ineffective.



Efficiency Engineering

Engineers solved the problem by using a reduction gear so that both the engine and prop would turn at a nearly constant optimum designed RPM. The T56 power section, for example, runs at 13,820 while the big props turn at their own optimum design speed. In the P-3 and C-130 this is 1020 rpm. Since the E-2 has a somewhat different prop, it is geared to turn slightly above 1100.

Like Giddap Gov'nor!

The propeller of the turboprop team is bolted to the shaft of a gear box which is driven by a constant speed jet engine. When the pilot pours on the coal, the propeller blade angle increases to absorb the increased power. When power is retarded, the blade angle decreases to allow the engine to keep turning at the same constant speed. The size of the bite of air chewed off and moved by the prop is determined by the amount of power generated by the engine. Low power=low pitch, high power=high pitch. In effect, the propeller serves as the engine governor. For T56's, the end result is about 4200 horsepower at the prop on A-7 & 10 series and 4590 horsepower on the newest A-14 & 16 versions.

Indeed, a formidable amount of oomph turning a nearly ideal subsonic thrust converter—at half the engine weight of its brother recip!

A-2D was one of Navy's first aircraft to use turboprop power.

Okay, Dad—Let's Start it

In the P-3 or C-130, the first engine is started from an external gas turbine compressor (GTC) unit or self contained APU in the aircraft (also a GTC). Once the first engine is started, the GTC is disconnected and the remaining engines are started by compressed air bled off the compressor of one or more of the running engines. Both the E-2 and C-2 require ground GTC units to start each engine.

The engine starters are small turbines mounted on each engine's reduction gear box. Once the pilot energizes an engine's start switch, compressed air is directed on the small starter turbine and the engine starts turning. As the engine accelerates, nearly everything is automatic—requiring only pilot monitoring. At 16 percent, ignitors are activated* and the fuel cutoff valve opens* admitting fuel into the engine. The engine continues to accelerate and should light-off sometime before 24 percent. Even though the engine lights off, the starter continues to work to help it accelerate up above self-sus-

*By an engine-driven speed-sensing switch.

taining speed—speed above which the engine can run *and accelerate* on its own. This is somewhere around 60 percent for the T56. At 65 percent the igniters are automatically turned off—with blowtorch-like, constantly burning fire in the combustion chambers, there's no need for further ignition. The engine will continue to accelerate to ground idle.

The 'Go or Whoa' Handle

Cockpit power control for a turboprop engine is fundamentally simpler than for most reciprocating engines. One basic control per engine, the power lever, regulates power. The fuel control and the propeller control accurately readjusts as necessary to provide the demanded thrust. Push the power lever forward to go faster and pull it aft to go slower. If pulled *all* the way aft, up to 1100 or 1200 continuous shaft horsepower is available by means of reverse pitch. Real "whoa" power for landing on an icy, wet or short runway.

Let's take a look at a power lever in the P-3.

Diagram of P-3 Power Lever

The power lever quadrant is divided into two basic ranges: the ground range and the flight range. Normal engine speed in both positions is, for all practical purposes and ease of understanding, a constant 100 percent or 13,820 rpm*. An exception will be discussed later.

The ground range (sometimes called beta range) of 0 to 34 degrees of power level travel is used for all ground operations except run-up and takeoff. Two positions marked START and GROUND IDLE are located near the center of the ground range.

At START, the propeller is near the zero thrust blade angle in order to minimize resistance to turning and to reduce the load on the starter.

At GROUND IDLE, the propeller is producing just enough reverse thrust to offset the jet thrust from the exhaust.

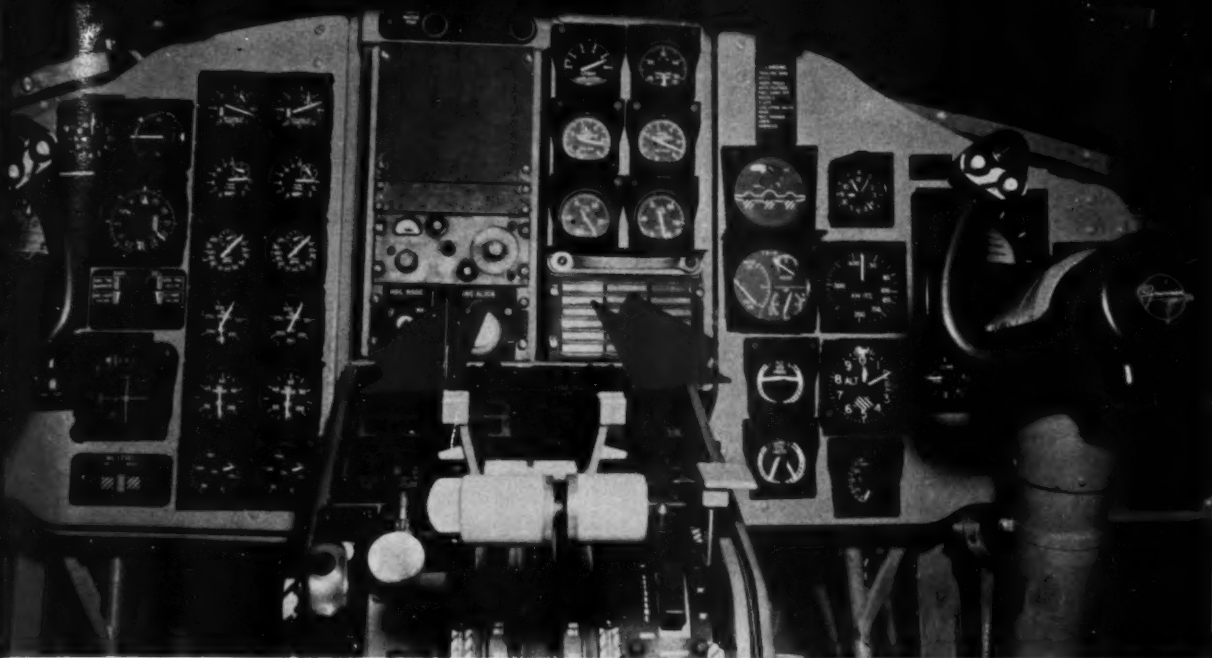
Advancing the power lever toward the 34-degree flight idle position causes the fuel control to meter more fuel for power and schedules the propeller to increase pitch to accommodate the increased power. Pulling the power lever back toward zero from GROUND IDLE also increases power output, but in this case, the propeller moves to a reverse pitch.

In the flight range (34 to 90 degrees), it is not necessary to change engine speed to change the power output. The engine maintains about 100 percent throughout the entire range. Power produced depends solely upon the amount of fuel being supplied for combustion. Advancing the power lever causes the fuel control to supply more fuel. As the fire burns hotter, the gasses expand more and attain a greater velocity as they force their way out the back of the combustion chambers. The higher the velocity of the gases, the more power is extracted by the turbine blades. Since the engine will tend to speed up, the propeller will increase pitch, or take a bigger bite, to maintain a constant speed. As with all constant speed props, this evolution of maintaining RPM is immediate and almost imperceptible.

In moving the power lever from the flight range into the ground range, a definite detent or gate will be felt at 34 degrees. The purpose is to prevent the power lever from inadvertently being moved from the flight range back into the ground range while in flight. It is necessary for the pilot to deliberately lift the power levers up and over the ramp or gate to enter the ground operating range.

As stated previously, the T56 runs at about 100 percent all the time. There is one exception to this. Pilots of P-3s and C-130s when operating

*For the pure and precise at heart, actual P-3 RPM is Normal Ground Idle; 96.3—99.1 percent; Flight Idle; 94.5—98.4 percent; Takeoff, Military, Normal and Maximum Cruise, 99-101 percent. T56 installations in other aircraft have very similar RPM settings.



E-2A cockpit. Note condition levers (arrows). C-130 similar.

in the ground range can switch an RPM selector switch from NORMAL to LOW. This will cause the engine to go from the 100 percent normal ground operating RPM to about 73 percent. Two advantages are quieter operations and better fuel economy for low speed ground operations. The power lever continues to schedule both fuel and propeller blade angle as before—it is merely down-shifted to maintain a lower constant RPM.

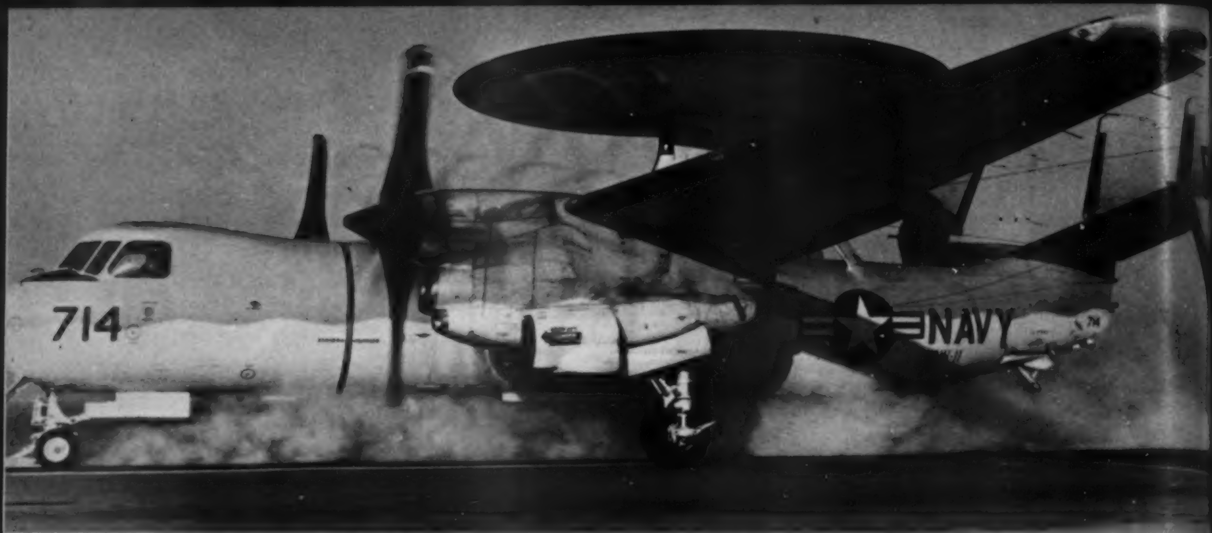
In the E-2, while the engine could be operated at lower ground RPM, this feature is not available since the engine is directly coupled to the generators. By keeping the engines at a constant RPM at all times, heavy constant speed drive units are not necessary for the alternators.

E-2s, C-130s and C-2s also have a "Condition Lever" for each engine located on the cockpit pedestal next to the power levers. Each Condition Lever has four positions: FEATH, GRD STOP, RUN and AIR START. Placing a Condition Lever to GRD STOP will shut off fuel to the corresponding engine. The engine will come to a stop without the prop feathered. In the air, when the lever is moved toward FEATH, it mechanically and electrically cuts the fuel and feathers the propeller. Moving the lever from FEATH past GRD STOP to RUN supplies electrical power to the engine's speed-sensitive switch which, in turn, opens the fuel shut-off valve during a start cycle. By moving the lever to AIR START, the propeller is caused to unfeather. When starting an engine in flight, the condition lever must be *held* at AIR START and the power lever left at flight idle until the engine is started. When released, the condition lever automatically returns to RUN and remains there for all normal operations.

In the P-3, however, the functions of the Condition Levers are accomplished with separate switches. Fuel and Ignition Cut-Off switches accomplish the "GRD STOP" and "RUN" by being either OFF or ON. Feather buttons accomplish the task of feathering an engine (when pushed in) or AIR START (when pulled out).

In many respects, instrumentation is similar to that found in the recip transports and patrol airplanes. Tachometers; oil pressure, temperature and quantity gages; fuel pressure, fuel flow and quantity gages; and oil cooler flap position indicators are still there. Missing are such instruments as manifold pressure, cylinder head temperature and cowl flap indicators.

One stranger is a Turbine Inlet Temperature indicator for each engine. This gage allows the pilot to monitor the operation of an engine. The temperature of the gases just downstream of the combustion chambers is a good indication of the power output. It also provides a clue to the pilot as to how well the complex hydro-mechanical-electronic fuel control system



As aircraft increases speed, props take a bigger "bite" to keep RPM constant

is scheduling fuel for the prevailing operating conditions. It's sort of a combination power and performance indicator. In the event of fuel control malfunction, this instrument will be extremely important in manually scheduling fuel to an engine.

For each engine there is also either a horsepower or a torque indicator. Regardless of instrument installed, both do about the same thing—indicate the power output of its respective engine. This is detected at the extension shaft between the power section and reduction gear assembly. One will be calibrated in horsepower and the other in torque (inch-pounds).

How About Safety Devices?

Two types of failures are special hazards to a turboprop—a flameout, or overspeed of either the engine or propeller.

Power Loss

Drag induced by a recip that quits cold is relatively little in comparison to that which could result if the big propeller of a turboprop attempts to drive the compressor without *any* input from the turbine. This could happen, say if the turbine blades were ineffective due to a failure of the rotor shaft between the compressor and turbine or due to extensive damage of the turbine blades. The wide-bladed propeller would make very effective air brakes since it would attempt to supply about 6000 horsepower to drive the compressor at 100 percent.

A simple flameout does not cause as much drag but is still serious. Even though no heat is being added in the combustion chambers, the turbine blades will recover a great deal of the power expended in compressing the air. Following are several automatic safeguards to provide against excessive drag from a dead engine:

▶ *Auto Feathering System** is designed to secure an engine should it fail during takeoff. It is turned on only during the takeoff and becomes armed when the power lever is advanced past the 75-degree position. After takeoff has been completed, it is manually shut off. If propeller thrust reduces below a certain point, a Thrust Sensitive Switch actuates and causes the propeller to feather *before* drag develops. This is very important since aircraft yaw from the drag of a failing engine can be especially critical at takeoff. It is perhaps pertinent to note that when a propeller is feathered on a turboprop, the feathering system shuts off fuel to the same engine.

▶ *Negative Torque System (NTS)* provides a constant protection against high drag in flight. This is a completely automatic mechanical-hydraulic system which sends the propeller towards a higher pitch when it absorbs an excessive amount of negative torque from the airstream (in the T56, at above 400 negative hp). The propeller moves toward feather until the negative torque is relieved. This cycle will repeat until power is increased or airspeed reduces to a level compatible to engine power.

▶ *Safety Coupling* is a backup device for the NTS. If the NTS should fail to operate, the safety coupling will decouple the reduction gear box-to-rotor shaft at a predetermined negative torque setting (in the T56, about 1500 negative hp). Once disconnected, the propeller will continue to windmill at governed speed until feathered.

*Not installed in the C-130.

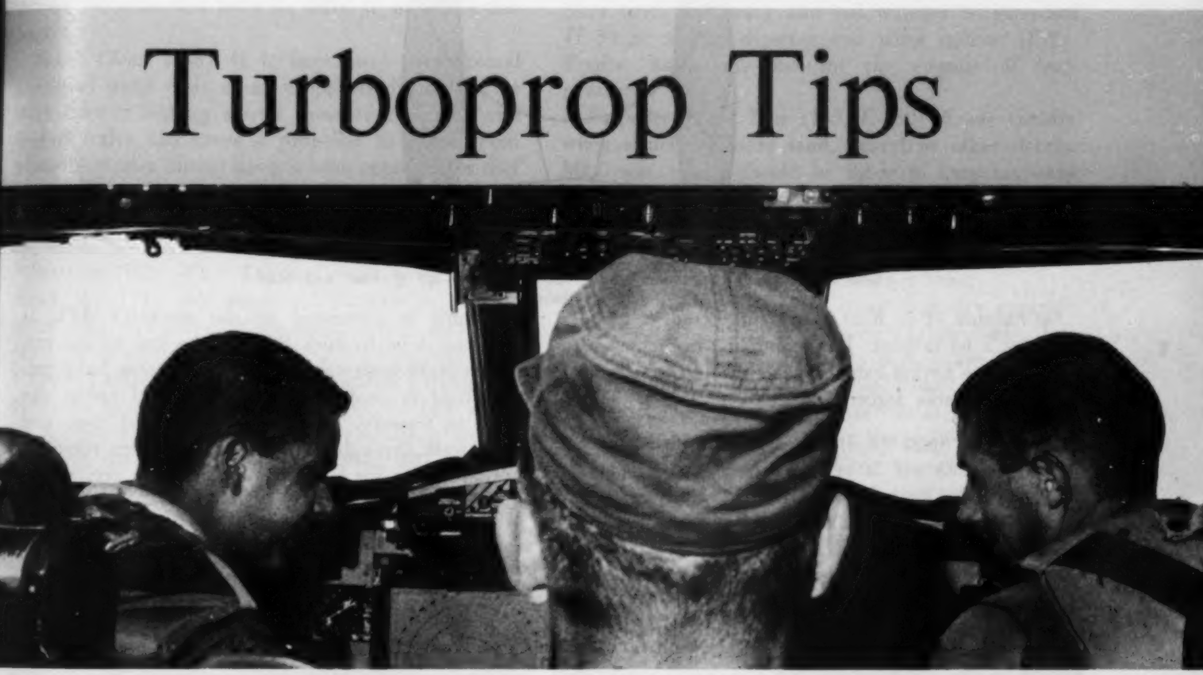
Prop/Engine Overspeed

The second type of trouble, overspeeding of the propeller or engine, could originate in many different ways. Therefore, both the engine and prop have individual protective devices in the event of this eventuality.

▶ *Pitch Lock* is a mechanical device in the propeller itself which is triggered to engagement should the propeller overspeed. In the T56, this will occur at about 103 percent engine RPM. Most pitch locks are caused by goofed-up governing systems; however, they can also be caused by rapid power transitions. With the pitch lock engaged, the prop cannot go to a lower pitch, nor can it govern itself. Sometimes the engine can be used for cruise if pitch lock has occurred; however, if the prop fluid pumps are operative, the engine should be shut down and feathered for landing since a pitch locked prop will not be compatible with low speed operation.

▶ *Fuel Control Overspeed Governor* protects the engine from overspeed and is considered a backup to the pitch lock. Sometimes called a fuel topping governor, it mechanically restricts or "tops" the fuel flow to the engine so that it won't exceed a certain RPM (about 107 percent).

Turboprop Tips



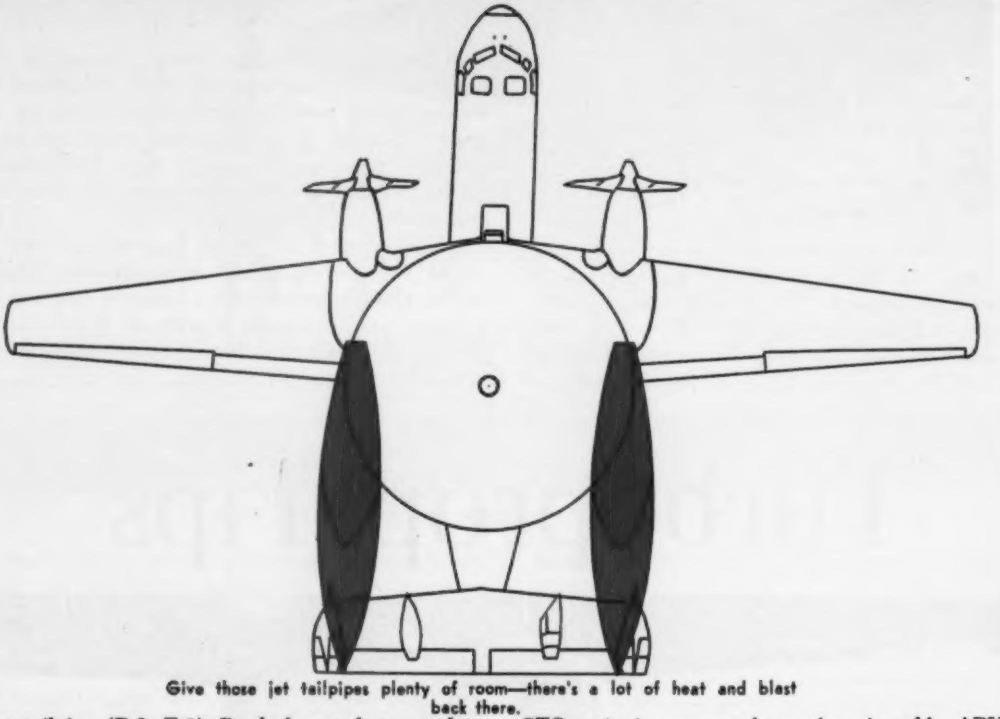
Out of the Engine and into the Cockpit

In order to compile a list of operational transition hints and tips, the author contacted a cross-section of Navy and Marine squadrons operating different types of turboprop aircraft. Some were training squadrons, in the business of transitioning new pilots. Other squadrons included a spectrum ranging from old hands to those just getting their first airplane. As one might expect, each had a slightly different transition suggestion to make—depending upon their experience level with the turboprop. Aircraft manufacturers, engineers, and test pilots also responded when asked the question, "What hints and tips would you like to pass on to a naval aviator who is about to transition to turboprops?"

Following is a summary of the information received. Aircraft designation (i.e. P-3) indicates the aircraft flown by the contributor. The same will probably apply to other turboprop aircraft too.

General Ground Operations

What did he say? (P-3) High frequency jet engine sounds can cause irreparable damage to hearing. Ground crews of transitioning squadrons must wear mickey mouse headsets if they are to adequately protect themselves from this hazard.



Give those jet tailpipes plenty of room—there's a lot of heat and blast back there.

Jet tailpipe (P-3, E-2) Don't forget that a turboprop has a jet tailpipe. Danger areas are created aft of the engine by hot exhaust gases leaving the engine with considerable force.

Other Hot Spots (P-3) High temperature general ground velocity air is pumped overboard in places other than the jet exhaust during certain modes of ground operation. The oil cooler inducers take air from the 14th stage of the compressor which, after it goes through the oil cooler core, is exhausted out the oil cooler outlet during ground operations. 14th stage air is also used for ground air conditioning during ground operations in the P-3s without an APU. Hot air is exhausted on both sides of the nose through doors and immediately aft of the nose wheel well through a large duct. Keep clear—this air is hot.

Lost Cue (E-2) In the zero thrust condition of ground operation there is little or no prop-wash normally associated with a spinning propeller. Those used to operating in close vicinity of props, such as under the engine nacelle on a busy carrier flight deck, will not have this cue or warning of its presence when approaching from astern.

Bad Habit (All) Nobody intentionally walks through a prop arc! But line and flight crews, knowing that the prop will not turn unless an external GTC unit is connected or the aircraft's APU is operating, tend to duck through the arc during pre- or post-flight inspections. In times of stress, habit patterns tend to control reactions and bad habits can result in tragedy. The old adage "stand clear and never walk through the plane of propeller rotation" is appropriate for turboprops as well as recips.

The sharpest edges ever honed.

Start and Taxi

FOD (C-130, P-3, E-2) Since it is basically a jet engine, Foreign Object Damage is a major problem area with all turboprop aircraft—even in the C-130s and P-3s where intakes are relatively high off the ground. Standard jet squadron techniques apply and must be adhered to in order to control the problem. Whenever practicable, start and run the engines on a paved surface to minimize the possibility of foreign objects being picked up by the propellers and being drawn into the compressor. Good housekeeping on the flight line, sound maintenance procedures and continuous education of personnel are among the steps that must be taken to minimize this hazard.

Stand Clear (P-3) It is imperative that ground personnel stand clear of *all* propellers during engine start since a leaking starter pressure regulator and shut-off valve can cause a propeller to rotate, even when the starter button has not been operated for that engine. They should also keep clear of the propeller plane, due to the risk of injury from starter fragmentation.

Starting (P-3) When starting a turboprop engine, *watch the TIT*. Hot starts will injure an engine faster than any other single cause. Never move the power lever during start.

Flight Clearance (P-3, C-130) Like all jet engines, the turbo prop has a hearty appetite for fuel when it's on the ground. At idle each turboprop engine will burn 40-60 lbs of fuel/min. Fuel will be conserved if you call for clearance before starting the engines. If a long delay is expected, plug in the APU and wait until clearance is delivered before cranking up.

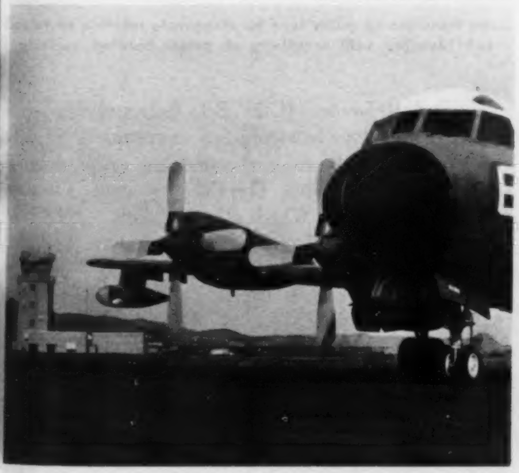
Parking Brakes (P-3) Should be set when the aircraft is stopped and a slightly positive blade angle should be selected. This will prevent an inadvertent backup and will also provide a slight flow of air across the oil cooler. The backing-up qualities of the turboprop are very subtle and should be guarded against, particularly at night.

Backing Up (E-2, P-3) With the use of reverse thrust, it is possible to back a turpoprop out of a boxed-in situation. Just make sure there isn't any loose equipment or personnel in front of the plane to blow over. Post wing and tail watches on intercom (P-3) or a taxi director and wing walker (E-2). Engine limitations—monitor the engine oil temperatures.

Propeller Blade Tips (P-3, C-130) Erode rapidly when struck by loose sand, gravel or other debris. Maximum efforts should be made to keep taxiways and runways clean. If such an area exists and can't be avoided, the best way to go through is at ground idle with slight positive thrust. The worst thing to do would be to reverse thrust at such a time.

Engine run-up (E-2) On other than dry concrete runways or with low gross weight (low fuel), full power turnup of both engines may cause the aircraft to skid even with brakes locked. Whenever making such a run, be sure that you are clear ahead and do not become absorbed in the cockpit.

Big Wind (E-2, C-130) Keep a vigilant eye toward smaller aircraft and their eagerness to cross behind a section or division of T56s. Developing



IFR clearance? Fuel will be conserved if you call for clearance before starting the engines.

C-130 leaps into the blue.

A-4 on its nose after passing behind a C-130 at full power.

full power with the C-130, for example, creates a gale force of 30 kts as much as 500 ft aft of the aircraft. A-4s seem to be especially susceptible to this hazard.

Returning to the Line

Down Shifting (C-130) When switching from NORMAL to LOW speed ground RPM, actuate each selector switch individually rather than all of them simultaneously. It's easier to monitor the instruments of just one engine in case something goes wrong.

Opening the hatch (C-130) The crew entrance door is not opened from the outside of the aircraft. Releasing the door from the outside, with pressurization inadvertently still on the aircraft hull could result in a nasty bump to unsuspecting ground personnel. To be safe, ground personnel should wait until a crew member releases the lock from the inside.

Low RPM when in ground range will reduce noise.

Some transitioning pilots tend to exaggerate rotation on takeof until familiar with sensitivity of power boosted controls.

Habit Interference (C-2) E-1, E-2, and S-2 crew depart from a door located aft of the props. A prudent practice is to walk aft and avoid the prop—even if the engine isn't running. The C-2 crew door is located ahead of the prop. Watch it!

Takeoff

Cold Weather (E-2, C-130) Under low ambient temperature conditions, never set the power levers to MAX POWER without monitoring the torque or horsepower indicators. At temperatures below freezing, it is possible to exceed maximum allowable shaft horsepower without exceeding maximum allowable Turbine Inlet Temperature (TIT). In addition, increasing ram effect during the takeoff will increase shaft horsepower for any fixed TIT. This means that either torque (or horsepower) must be set below the

maximum allowable when setting power for takeoff, or that power must be reduced as airspeed builds up. Since the reciprocating engine is less able to develop this excess power under such conditions, transition pilots beware.

Pitch Lock on Takeoff (C-130) This can be a sticky situation—especially if an abort is attempted. Remember, the pitch-locked prop is fixed and cannot go to a lower pitch. Therefore it won't reverse with the rest of the props in an abort. This will give the pilot all sorts of directional control problems. Know the pitch lock abort procedures for your aircraft cold—expect at least some directional control difficulties.

General Flight Operations

Power Response (E-2, P-3) Because the turboprop is virtually a constant speed engine in the flight range, power changes are accomplished by changing the flow of fuel. Additional power is immediately used up automatically and almost instantaneously by the prop taking bigger bites of air, rather than spinning faster. For the pilot, the actual result is very rapid power response. Even small movements of the power levers can be felt immediately in the seat of the pants.

Jet Set (E-2) The transitioning ex-recip pilot must acclimate his flying habits to that of the high altitude world of the turboprop. Higher airspeeds, higher rates of descents with the associated steep angles and much greater turning radii are a few of the problems in this regard. Power availability, for example, is such that the airspeed can be changed in straight and level flight by more than 100 kts in a very few seconds.

Premature gear retraction during takeoff—and the shrapnel flew!

TOP: The turboprop world requires high altitude procedures. BELOW: two-engine formation with power to spare.

Torque (E-2) Along with a tremendous amount of horsepower produced by a turboprop, in the E-2 there is also a good deal of torque. The possibility of running out of right rudder is very real—especially during takeoffs with a moderate or heavy crosswind. The same torque-crosswind combination can be found on a carrier with possibly more serious results. Deck runs down the angle at light gross weights with an axial deck wind can cause the aircraft to veer to the left, even with full right rudder applied.

Throttle Application (P-3) When power is applied or retarded on the turboprop engine, the throttle should be positioned with authority in a firm and steady manner. Do not *jam* your power control in either direction! Remember, you have a propeller on the end of the engine which has to respond to your command and this takes time. Firm, steady throttle movement permits the engine/propeller combination to answer your commands. Jerky,

fast throttle movement causes momentary confusion in the system. This can result in actuation of some of the safety devices in the powerplant system although really the only problem is the pilot or engineer handling the throttle.

Power-boosted Controls (P-3) Require getting used to in some cases. Until the transitioning pilot becomes familiar with the sensitive controls, he is likely to overcontrol. For example, P-3 transitioning pilots sometimes exaggerate rotation on takeoff so as to produce an abrupt leap or zoom from the runway to climb attitude. Considerable "aileron action" can be experienced during early phases of check-out, especially during climbout and in the landing pattern. One habit carried over by P-2 drivers is a tendency to lead with rudder when commencing turns. Most will soon learn that for bank angles up to 20 degrees, little or no rudder pressure is required.

Some crewmen have duties which require them to be unstrapped.

Crew Consideration (P-3) With turboprop aircraft so responsive to power changes and with sensitive power-boosted controls, smooth handling of the aircraft is extremely important. Crewmen who have to be unstrapped and standing while performing their duties are especially susceptible to rough handling of the plane. A seemingly harmless action like suddenly pulling the power levers back to flight idle can throw a crewman to the deck or against bulk-

Ever tried walking the length of a patrol plane when it's making like a fighter?

heads. Sudden large power applications can cause an unsuspecting crewman to backpedal from the flight compartment clear back to the afterstation bulkhead, unless he collides with something enroute. Ever tried walking the length of a patrol plane while it's making like a fighter? Smoothness in flight is a mark of real competence in *any* airplane. The golden rule: "For the benefit of the boys aft of the pilot's throne, relax the muscles holding the yoke and power levers."

Naked Ears (C-130) A flight surgeon reports that noise level within the flight station is deceiving. Seemingly, the noise level is at a minimum; however, long flights produce an unusual degree of fatigue in certain personnel. Cause of this fatigue is thought to be vibrations (not unpleasant) which penetrate the naked ear, the bone and tissue surrounding it. Wear your headsets or protective helmets.

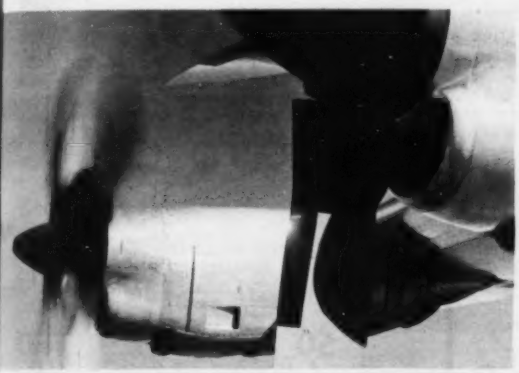
Lookouts (P-3) Due to the increased cruising speeds of the turboprop, visual lookouts became more important than ever. Initial crew training should emphasize the necessity for lookout stations to be

Visual lookouts are more important than ever.

manned by well-briefed crewmembers during all flights operating in areas where other aircraft might be encountered. The briefing should emphasize the need for ICS check before takeoff to insure good internal communications just after takeoff since this is usually the time when the pilot, copilot and flight engineer are preoccupied with cockpit instruments.

Overtemperature (C-130) This is extremely serious in any jet engine, and the turboprop is no different. For prolonged engine life, learn to control and live with the lowest temperature required to get the job done.

Engine Shut-down (C-130) If you shut an engine down for any reason, never try to catch it. The automatic features of the starting sequence must work at consecutive and specific RPM. If the sequence is started somewhere in the middle you almost always lose a turbine. At 13,000 bucks—it sure smarts!



Make sure a feathered engine has cooled off a bit before restarting.

Single Engine In the E-2 or C-2, intentionally shutting down an operating engine can cause serious problems. Failure of the other engine precludes the possibility of unfeathering the good one since the generator on the failed engine cannot produce enough power while windmilling on the NTS stop. Remote? It has happened!

Restart (C-130) Never restart a T56 with a residual temperature above 200°. Dumping raw fuel into a hot engine may produce results which range from a hot start to an explosion within the engine.

Icing conditions (E-2) The E-2 has anti-icing provisions for the engine inlets. Do not wait for ice to build up on intake ducts before turning the system on since this allows the ice to be ingested into the intake duct as it breaks off—thence into the first stages of the compressor. Use anti-icing for anti-icing, not deicing.

Unhealthy (E-2) Experimenting with reverse or ground idle as a speed brake in flight can only lead to trouble. Chances are you will flameout and decouple the engine sometime before the crash.

Know Your Systems (P-3) Although the pilot routinely positions a few switches and uses only the power levers to control thrust, a multitude of devices are involved. When a malfunction occurs, flight crews must be prepared to quickly identify the character of the trouble in order to act appropriately. This requires more than a casual acquaintance with the various systems and the safety devices built into these systems, for in some circumstances the situation will deteriorate rapidly if the wrong action is taken. Of course the NATOPS manuals contain procedural instructions for various circumstances, but it is difficult to foresee every contingency and memorize lengthy procedures without some working knowledge of the design.

Inflight Troubleshooting (P-3, C-130) Concepts of turboprop operation differ greatly from straight jet or reciprocators. Even jet mechs have problems when first transitioning to the T56 engine in grasping the fact that the major range of power output occurs with the engine at a constant 100 percent. Propeller blade angle and fuel flow control the power output—not RPM. Therefore, many old rules in determining malfunctions must be set aside and greater use of instrument indications, or combinations thereof must be utilized to ascertain the malfunction in the engine, gear box or propeller. If your powerplant starts acting up in flight or has to be shut down because of a problem, give the mechanics a break. Record everything you can at the time the emergency occurs. An example of parameters to be recorded would be fuel flow ,TIT, torque/shaft horsepower, RPM, airspeed, altitude, free air temperature and any other symptoms noticed, such as warning lights, power changes prior to the malfunction, . . . There is never too much information on a flight squawk.

Look-Listen-Feel (P-3) Listen to your engines. Variation in RPM can be detected easily by an educated, alert ear. Feel your airplane—excessive vibration is an indication of a pending problem. Look at your gages—check to see that all engines closely approximate each other. Large discrepancies in fuel flow, TIT, shaft horsepower or RPM should be reported.

High Altitude Airways (P-3) Transitioning to a turboprop will place a good many pilots up in the high altitude structure for the first time. For the most part, the transitioning pilot will find it easier. However, high altitude terminal procedures are usually

the most difficult for the transitioning pilot since he is now flying a high performance aircraft.

Descent

Jet Penetrations (C-130) As published in High Altitude Approach Charts, can be executed in most turboprop aircraft. An item of particular interest in C-130s is the requirement to have airspeed well under control prior to pushing over for penetration. There are no speed brakes and once the 4000 ft/min rate of descent has been established (power settings at flight idle), the IAS builds rapidly towards the flight envelope limitation. In order to stay within limitations, the airspeed must be decreased, consequently the rate of descent suffers. It is very important that the airspeed be slow, say at holding pattern speed, prior to starting the descent.

Landings

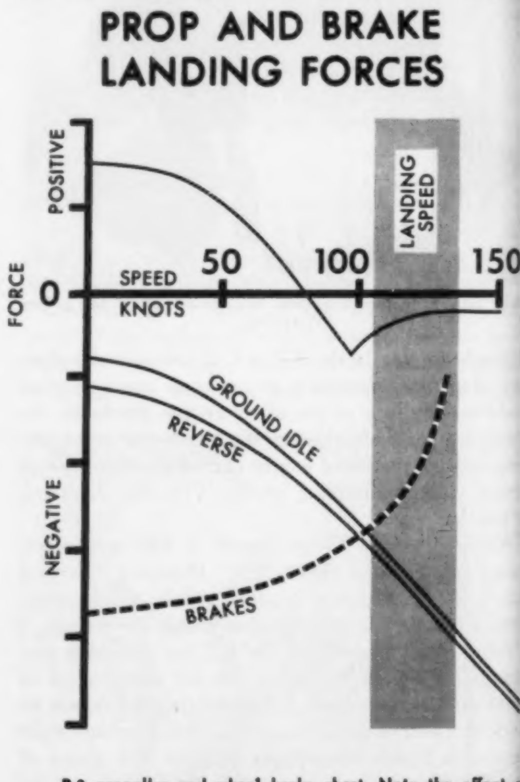
Angle of Attack Indexer (E-2) It takes the average recip pilot a great deal of time before he can mentally adjust himself to the fact that the airspeed indicator is not the aviator's greatest friend in the landing pattern. Even after he has mastered the odd little angle of attack indexer, it usually takes an appreciable number of landings to have the proper confidence in it. It's great though—especially bringing the E-2 aboard at night.

A Tendency (E-2, P-3) Some pilots transitioning from recips to turboprops have a tendency to start an early flare and ease power off. The aircraft may be 100 ft in the air when this happens. Since the engine and prop will be quick to respond, the effect will be to greatly increase the sink rate and cause the air speed to bleed off rapidly. One reason the transitioning pilot won't readily notice what is happening is that many of the flight sensations he was used to in the recips are missing. Sound level, for instance, will remain almost the same at any power setting. Airstream noise also doesn't change as much. Golden rule: *Avoid flight idle power during the approach unless absolutely necessary.*

Pitch Lock on Landing (P-3) Trying to apply reverse to a pitch-locked prop during landing rollout can only lead to a disastrous swerve. The other engines will reverse and the pitch-locked prop keeps going forward. Know how to check for a pitch-locked prop *before* moving the power levers to ground operating range. Once the shift to ground range has been made, make sure each engine has actually shifted before reversing.

Reverse Thrust (P-3) Ground idle will usually produce enough reverse thrust to slow the aircraft sufficiently. A straight rollout using both rudder control and asymmetric power in ground range will maintain centerline rollout. Full reverse should be used only when really needed. The transitioning pilot

Pitch-locked prop caused directional control problems when reverse thrust was added during the landing rollout.



P-3 propeller and wheel brake chart. Note the effect of going to ground idle. Big flat props create considerable drag without going to reverse. Top line is thrust when at flight idle.

Pilot overcorrected a swerve during landing then gave up. Instructor had head in cockpit monitoring instruments. Prop lights were ON when swerve commenced. By the time instructor took control it was too late to prevent it from leaving the runway.

should be alert to the possibility that directional control may be harder to maintain because blade angle settings for full reverse may vary slightly for each engine—causing the aircraft to veer a bit. If runway surface conditions are poor, or if there is loose sand, small rocks or other debris on the runway—minimize reverse power and save those prop blades. When hard braking has been used during landing rollout, try to use brakes sparingly during subsequent taxiing to allow heat to dissipate.

Slippery Runways (P-3) Ice or snow affects primarily your technique in applying reverse thrust and brakes. By easing the power levers into the ground operating range and cautiously applying reverse thrust at a slow rate while coordinating rudder, there will be little tendency to skid. Use brakes sparingly and feel out traction. The use of brakes at moderate speeds on surfaces that have poor braking action can foul-up the good directional control you have with the asymmetrical reverse effect and rudder. Nose steering lacks effectiveness under these conditions.

Snow-Covered Runway (P-3) Reverse thrust will probably be used until the airplane is almost stopped. If loose snow is present on the runway, the use of high power in reverse, at low speed, will result in a cloud of snow ahead of the aircraft and will obscure forward vision.

No Flap or Boost-Off Landings (P-3) It is extremely important during no-flap or boost-off landings, or for any high speed landing, to check horsepower or torque gages and other power indicators (i.e., Beta lights) when power levers are retarded to the ground range to make sure all prop blades are changing pitch normally in relation to power lever position. This precaution is important because the pitch lock of a prop should be detected immediately so that prompt corrective action can be taken. It is recommended that additional simulated emergencies not be introduced when a trainee is making a boost-off landing. A simulated engine failure during a boost-off approach or landing is especially dangerous from the controllability standpoint.

Them That Flies 'Em, Like 'Em

For the pilot transitioning to turboprops, it is a comforting thing to see that old familiar, reliable and efficient propeller out there on the wing. With all those horses harnessed up and "chompin' at the bit," it's an easy matter to gallop down the runway, leap over the fence and climb out with ease, then operate at altitudes previously considered strictly the stomping grounds of the jets. In fact you can now keep up with some of the tailpipes. Yep, you'll like the plane very much. In this respect, it is perhaps significant to pass on what one P-3 squadron skipper believed the most important problem in the switch:

"The greatest problem is complacency caused by the multiplicity of automation, greatly increased comfort factor and the decrease in noise level. Pilots tend to develop the attitude that things seldom go wrong with the turboprop and that if something does malfunction, it is either automatically rectified or a single action on the part of the pilot or flight engineer will remedy the trouble. This, of course, is not always the case."

The author expresses appreciation to the following Navy and Marine squadrons for their assistance in the preparation of this article. These organizations were quick to respond as were industry's engineers, tech reps, and test pilots.

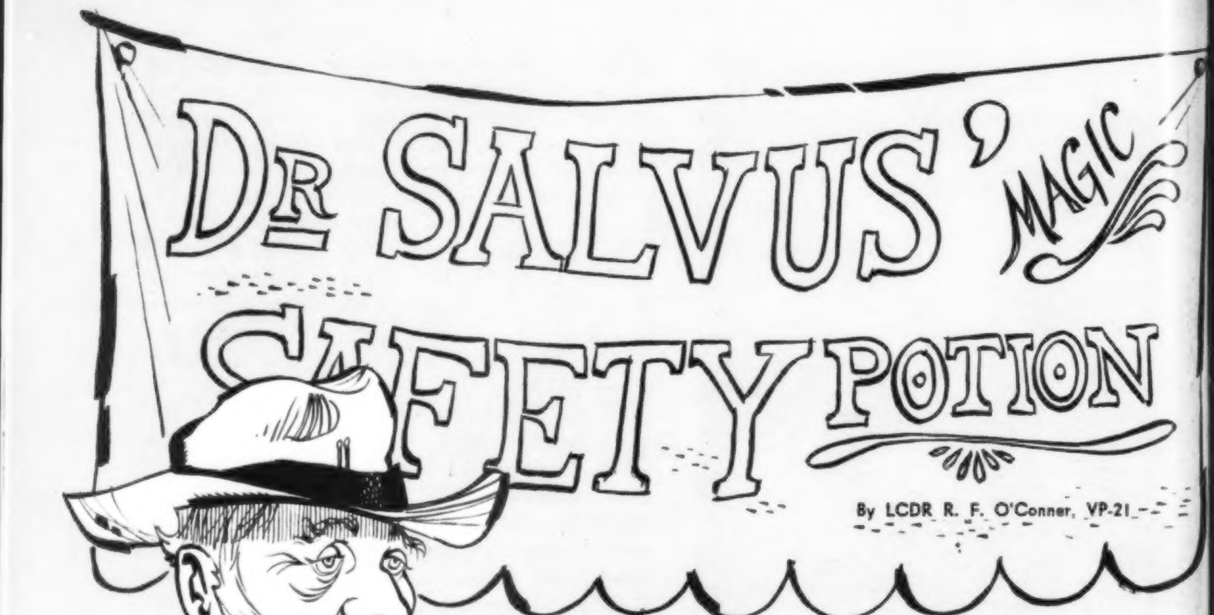
Navy and Marine Squadrons

E-2: VAW-11
P-3: VP-10, VP-16, VP-26, VP-28, VP-30 Det A, VP-31 Det A.
C-130: VMGR-352, VR-22

Industry

LOCKHEED-GEORGIA Company (C-130)
LOCKHEED-CALIFORNIA Company (P-3)
GRUMMAN AIRCRAFT ENGINEERING Corp. (E-2, C-2)
ALLISON General Motors (T56)

Dr Salvus' Magic Safety Potion



By LCDR R. F. O'Conner, VP-21

Only $2.98 for Dr. Salvus' Magic Safety Potion. Rub it on in the morning and relax—no accident can mar your day. Good for P-2s and S-2s, A-4s and F-4s, Beechcrafts and Gooney Birds—anything that flies!"

Sound good? It promises a lot for a small expenditure but, come to think of it, wouldn't it be great if such a safety cure-all were available to us in aviation? Consider the savings in money, aircraft, man-hours, and most important, lives. Consider the increase in efficiency and combat readiness. And consider the unprecedented objectives that could be reached by utilizing these savings.

But as is the case with all schemes that promise something for nothing, Dr. Salvus is a fraud. His so called "Magic Potion" is nothing more than sugar flavored water. Although giant strides have been made in the field of aviation safety, no one has as yet developed a guaranteed remedy for the prevention of aircraft accidents.

What's that you say, my friend? You couldn't be duped by a phony snake oil salesman like Dr. Salvus. Well, maybe not, Buddy, but remember that P. T. Barnum didn't exactly end up as a pauper.

Although Dr. Salvus, or any of his kind who claim to possess a positive cure-all for aircraft accidents are charlatans, let's not be discouraged. All is not lost. We've all heard the expression, "Stick to the brand name products." There are a number of these on the market that, when taken as prescribed, really can succeed where Dr. Salvus, with his "Magic Po-

tion" is sure to fail. The man to see for these "brand name products" is the unit safety officer.

One of the definitions of doctor is, "a teacher; one who inculcates learning, opinions, or principles." In this sense, the safety officer is a "Doctor of Aircraft Accident Prevention." Unlike Dr. Salvus, Dr. Safety doesn't claim the ability to prevent Aircraft accidents by magic. He's not a miracle worker, he's a teacher. His job is to teach us to use the many safety medicines available to us in naval aviation. None of them are cure-alls, and all of them are as useless as Dr. Salvus' "Magic Potion," unless each and everyone of us cooperates fully in the safety program. This applies equally to the commanding officer, the newly reported airman, and each of us in between.

What are these medicines that Dr. Safety dispenses? Let's consider a few.

Command Attention: If the medicines prescribed by Dr. Safety are bitter and hard to take (as medicines often are), a little prodding by someone in authority helps to insure that the medicines are taken. But the commanding officer can't do it alone. This brings up supervision.

Supervision: Almost all of us are supervisors to one extent or another. Each of us must strive to see that safe procedures are always followed. We must all bear the responsibility for a good safety program by continuously supervising the practices of those subordinate to us. This is especially important during an individual's early training when he is most impressionable.

Training: Training increases knowledge and knowledge improves judgment and judgment is necessary for an effective safety program. An important ingredient of training is personal example.

Personal Example: Our actions make strong impressions on those under us. Only if we consistently practice what we preach can we hope to train others in safe practices.

Courage: Often courage is required in order to maintain an effective accident prevention program. Courage to make difficult decisions, courage to persevere for the sake of safety, against the derision of those who hold any safety program in contempt.

Morale: As was so succinctly stated by Mary Poppins, "A spoonful of sugar helps the medicine go down," and high morale is the sugar of the safety program. A unit with high morale is likely to have a strong safety program because good morale makes the stringent requirements of an effective safety program easier to take.

These are but a few of the many ingredients that make up an effective accident prevention program. We can all think of many more. We in naval aviation must take these medicines, and we must follow the treatment prescribed by Dr. Safety. We must, that is, if we hope to improve the health of our own aircraft accident prevention program. Come to think of it, do we really have a sensible alternative?

Ice on the Runway

At the end of an 11-hour midwinter patrol the *Neptune* turned onto final for a night precision radar approach to runway 10 at an Air Force Base.

Weather was fairly decent. Surface wind was 350 degrees at 10 kts and the ceiling was 2500 broken. Visibility was seven miles. Runway 10 was covered with patchy slush and ice and braking action was poor, but the pilots didn't know this. For some reason, the controller did not pass along runway conditions, as required by base directive, and the pilots did not ask for it.

The crew navigator (a PP3P) was flying the approach. On short final he had a little trouble with the landing light switches but managed to get the port light partially extended in time. Natural lighting was good, however, and touchdown was smooth, on centerline and within the first 100 ft of the 10,000-foot runway.

During initial rollout a slight swerve was quickly straightened with right rudder and brake. The reversing throttles were cracked in slowly and evenly. There was plenty of runway left.

At 60 kts the pilot came out of reverse and then easily corrected for another slight swerve to port.

The rudders became ineffective a few seconds later, about the same time another left swerve started. This time the 30-ton patrol plane did not respond, even though right rudder, brakes, nosewheel steering and starboard reverse were used in the attempt to straighten it out.

The PPC (in right seat) took control and continued starboard reverse, increasing RPM in an attempt to salvage the situation, but it didn't help.

The P-2 skidded off the port side of the runway about 6600 ft from the approach end, rammed through a small snow bank at about 20 kts (still in reverse) and finally ploughed into a larger snow bank just outboard of the runway lights. Reversing was stopped when the airplane lurched to a stop with its nosewheel and starboard main mount on the runway apron. Its axis was parallel to the runway. Both engines were secured and the plane was evacuated.

Conclusions

Neither pilot knew that the runway conditions were as hazardous as those actually encountered. This oversight contributed significantly to the mishap.

The runway condition on display in approach control when the P-2 landed was a reading of 16 on a scale varying from 02 to 26. This scale is a measure of the braking action obtainable based on runway conditions (ice, snow, rain or dry). Braking action in a 02 situation is practically nil, while a reading of 26 indicates the best possible braking condition.

The Airdrome Officer had obtained a new reading of 07 at 1700, just 45 minutes before the P-2 landed, and had passed it to the tower and approach control.

At that time, approach control was manned by a supervisor and a trainee, and both were occupied in monitoring radar scopes. Thus, the new data was never displayed.

Since this was the situation in approach control, it is quite likely that the pilots would have received an incorrect reading had they asked for or been briefed on runway conditions. However, if the old reading of 16 had been passed to the aircraft, it's possible that the PPC would have requested a verbal description of runway breaking action. In obtaining this information the controller would probably have recalled the more recent runway condition reading (07) or have been reminded of it by the tower operator. This is all speculation, but the outcome might have influenced the PPC to make the landing.

The decision of the plane commander to allow one of his copilots to make the approach and landing under the existing conditions (in addition to runway surface) also contributed to this mishap.

One endorser had some thoughts on this type of pilot training. "It is accepted that one of the prime responsibilities of the plane commander is the training of his crew. This includes permitting pilots in train-

ing to make their share of approaches and landings. However, when runway conditions or weather are marginal, adverse or not normal, then it is no longer a training situation. The combination of a night landing on an icy runway at a strange field and at the end of a long tactical mission does not lead to a normal training situation."

The PPC, as copilot, was partially involved in monitoring the other pilot's actions and this probably delayed corrective action on his part. Had he made the landing, his response to the unexpected runway surface condition might have been more timely and effective.

Lack of runway illumination on the starboard side during the rollout may also have delayed the PPC's decision to take control. Had he been able to see what the surface was actually like he would probably have taken control much sooner.

Although the difficulty with the landing light switches did not adversely affect the smoothness of the landing, one endorser felt that the confusion arising in the cockpit at this point on final warranted a waveoff. Here are his comments. "All pilots have been instructed as to the desirability of a waveoff if landing conditions are not normal or as anticipated. Every effort has been and will continue to be exerted to suppress the attitude that good pilots don't take waveoffs. If a safe flight requires the pilot to go around then this is the procedure to be observed."

Recommendations

- Reemphasize and expand the present program of providing information and instruction in the techniques of landing on ice or snow-covered runways.
- Reemphasize to PPCs the importance of sound judgment in deciding whether to let inexperienced pilots make approaches and landings at fields where marginal conditions exist.
- If the runway condition reading received is unclear, or it meaning uncertain, then ask for a report on runway braking action in terms of Nil, Poor or Good, or some other understandable choice of expressions.
- Plane commanders should insure that copilots are fully briefed on what procedures will be utilized during approach and landing, including action that will be taken upon encountering any usual circumstances, anticipated or otherwise.
- Emphasize the importance of ascertaining field and weather conditions, especially at this time of year, before landing or commencing an approach.

One endorser felt that pilots often did not seriously consider the effects of runway relative wind conditions. "A mental calculation of the wind's effect on the aircraft," he stated, "should be a 'second nature' type pilot reaction. If this thought pattern is not in evidence, a tendency to unconsciously ignore the reported surface wind will result.

"In this particular case, approach control and GCA tapes reveal that the pilot did not receive the surface wind conditions until arriving at a position about four miles from touchdown in the PAR pattern. This of course, is a busy interval in the approach and is an excellent example of a situation where the pilot's assimilation and usage of information must be second nature."

No one was hurt in this mishap and aircraft damage was light. A relative inexpensive lesson, but it emphasizes that a landing on an iced-up runway in a crosswind isn't "made" until the bird is turning off onto the taxiway, and even then it's wise to take it easy with the nosewheel steering.

This P-2 was equipped with snow tires but it still got away from the pilots at a very low speed . . . something to keep in mind when crosswinds blow and braking action is on a holiday until the snow thaws.

RUNWAY CONDITION READINGS

RCR	Braking Action	% Increase Landing Roll
01 to 05	Poor	100% or more
06 to 12	Fair	99%—50%
13 to 25	Good	49%— 0%

When relaying runway conditions to aircraft, Navy tower operators will state the RCR and give a description of the surface and braking action. For example: Runway 19L, ice on runway, RCR 04, braking poor. Naval Air Facilities having equipment to measure runway braking action by decelerometer are listed in the USN Notice to Aviators, dated 25 October 1965.

WHAT PRICE EXPERIENCE

I was one of two Mediterranean Skymice (A-4's) banged off the catapult from USS MOUSEHOUSE at dusk. Our mission called for a short night flight at high altitude.

After boring up through several layers of clouds we popped out into the glow of a full moon—on top of everything and began thoroughly enjoying the flight.

At CCA marshall the two of us were joined up, had received our Expected Approach Time, and were doing high power racetracks with speedbrakes out trying to burn down to landing weight. Everything was going nicely and we would be burned down sufficiently to start an approach at EAT and be right at max landing weight in the groove.

Just prior to starting down we were both eyeing a group of vicious-looking thunderstorms which had appeared in the vicinity of where the tacan indicated the ship to be. Oh well, I thought, the ship is probably located on the edge of the storms.

Just as we broke up to start down, MOUSEHOUSE called and told us to "dog and conserve." We didn't know it but this was the beginning of a flail. Five fighters had already departed marshall ahead of us and we figured there must have been some kind of deck crash and that recovery would resume in a few minutes. Anyway, we pulled in the boards, started conserving, and joined back up at marshall.

A few lightning flashes flickered in the group of thunderstorms previously sighted and about the same time MOUSEHOUSE control broadcast, "Standby to divert."

Sure enough, a minute later we were given a vector to our divert field and told to switch to MOUSEHOUSE departure control for radar tracking outbound. We switched and what we heard there came as somewhat of a surprise.

All of the five fighters ahead of us were also being diverted. Apparently those thunderbumpers were close to the ship and making things rough down there.

Each of the fighters was being individually controlled and the radio was crowded. Each of them was now low state so a sense of urgency prevailed. Altitude is a *Skyhawk's* best friend in conserving fuel. Since it looked as though wingie and I would be last to land at Divert, we continued climbing to 40,000 ft while we checked in.

Another frequency shift put us over to a foreign air control agency for further radar vectoring. We found the five fighters again—each of them trying to get a vector. Confusion built up with the controller getting excited and everyone shifted back to MOUSEHOUSE

ANYMOUSE

The purpose of Anymouse (anonymous) Reports is to help prevent or overcome dangerous situations. They are submitted by Naval and Marine Corps aviation personnel who have had hazardous or unsafe aviation experiences. As the name indicates these reports need not be signed. Self-mailing forms for writing Anymouse Reports are available in readyrooms and line shacks. All reports are considered for appropriate action.

—REPORT AN INCIDENT, PREVENT AN ACCIDENT—

control.

The divert field did not have NavAids which our aircraft could use so MOUSEHOUSE vectored all the fighters over the field and left it up to them to letdown through the three layers of overcast on their own (they didn't have fuel enough to do anything else). Penetrations were made by homing in on the tower with their ARA-25s. All were lucky, especially one of them—he flamed out while rolling out on divert's duty runway.

While inbound to divert we each tested the ARA-25. Mine varied by 80 degrees from my wingman's and we couldn't determine which was accurate. Both indicators had agreed with the tacan heading back to USS MOUSEHOUSE. I didn't like letting down blindly through three layers of cloud into an area surrounded on three sides by mountains without precise control.

Fuel for us hadn't become any real problem yet since we were sauntering at 40M at miser power. Therefore, I shifted back to the foreign controller to see if he had calmed down any. He hadn't but did manage to get across that we were to steer 040 degrees.

We turned to the heading and I inquired as to whether he had us in radar control. His answer was a series of accented "rogers' " so we continued 040.

But the clock was running out. After about 10 minutes our fuel was down to 1000 pounds. By now it was obvious that the controller didn't have us on his scope. We were lost!

Without hesitation we reversed course, shifted to guard and started squawking emergency. One station responded loud and clear in perfect English and inquired as to whether they could be of assistance. I asked for a DF steer or radar vector to which they responded, "My gadget is broken—out." I was unable to raise them again.

My tacan was still locked on the ship and I decided to head for home and let down through the thunderstorms, no matter how violent they were reported as being. Just as I was ready to punch the mike button to tell wingie what we were going to do, MOUSEHOUSE control came up on guard and said they held my emergency squawk.

In a situation like this there's no sweeter voice to hear than a ship's controller with a steer. An offer of another frequency for MOUSEHOUSE control was declined with thanks. Communications have a way of failing at critical times when shifting channels.

Since we were low state and under positive control, we made a tacan/radar-monitored letdown to the 180 position. This almost caused us to forget to lower tailhooks as they are normally dropped when departing marshal. Good old wingie remembered them during the idle descent which saved me a possible bolter.

Both aircraft were down to three or four hundred pounds of fuel but we had some good fortune. The ship broke out into a clear area long enough to take some of the strain off of us. Neither of us were used to coming aboard at such a light weight and it took considerable conscious effort to reduce the power sufficiently to keep on the glide slope with an amber indexer light.

We got aboard and taxied out of the arresting gear with no further incident.

Looking back at the whole affair I can see several mistakes and several correct actions. One mistake was the fact that we weren't ready to divert. My kneepad information was incomplete. I had fallen into the trap of seeing it in the ready room day after day and thinking "it's the same as it was yesterday, so I don't need to copy it."

Although the Air Ops NavAid information was copied down on my kneepad, I had not personally looked the facilities up in the publications. Had I done this, I would have found a brand new tacan station operating 10 miles away from the divert field.

I had sufficient fuel to comfortably make another field about 100 miles away that did have a tacan. Why didn't I? I've thought a lot about it but I can't really explain it. A sort of mental paralysis set in due to the urgency of the situation. I just didn't think of this one very important detail. But it won't happen again to me, I'll guarantee you that.

On the good side, we did right by climbing to altitude and staying there conserving.

We did right by not trusting an ARA-25 penetration when there was a possibility of error. Turned out the plane in error was mine.

When we determined we were lost, we admitted it by going to guard and squawking emergency. There was a tremendous urge to stay with the problem "just a little longer." The difference was the fuel. We no longer had spare fuel which is the margin for being wrong.

When we established communications with the ship, even on guard, we stayed there. We had an emergency situation and that's what guard is for.

I learned these things the hard way but I enjoyed an abundance of good fortune. I pass it on to you in case you get into a similar situation and don't have a ready answer.

HEADMOUSE

Have you a question? Send it to Headmouse, U. S. Naval Aviation Safety Center, Norfolk, Virginia 23511. He'll do his best to get you and other readers the answer.

New Safety Training Films

Two new technicolor safety Training films produced for CNO by the Naval Aviation Safety Center are now being distributed to navy film libraries throughout the world. Has your command seen them yet?

- **Safety Is Your Business,** MN 10003A—emphasizes the importance of personal and command attention in aviation safety.
- **The Big Payoff,** MN 10003B—stresses the value of individual quality control during maintenance.

Measure the Spring

Dear Headmouse:

Concerning the Harness Take-up Mechanism (inertial reel) on the MB-EU Mk-H5, our problem is this: The harness take-up mechanism has a spring-loaded snubbing unit which locks the shoulder harness in place upon ejection or sudden g-force; i.e., carrier arrestment. This snubbing action occurs upwards of 3G.

Is there a procedure, test equipment or device for checking this unit? The procedure we use is to place the seat in a test cradle and while one man is slowly pulling up the loop strap, another man hits the back of the seat sharply towards the front. This does cause the snubber to engage the loop strap but there is no way to know the g-force brought upon the seat.

If you can give us an answer we would appreciate it.

P. B. JENSEN SGT
VMFA-531, MAC-24
CHERRY POINT

▶ There are no test procedures nor test equipment available to provide a readable value for actuation of the snubbing lever. The snubbing lever spring plunger must be disconnected and disassembled in order to perform the only practical test. That is—measure the length of the Snubbing Lever Spring. The spring should measure not less than 1.347 inches. The use of NavWeps 13-30-18, Overhaul Instruction Mk-H5 Seat is the recommended reference for critical dimensions not shown in your Maintenance Manual. This information can be found on page 26, paragraph 2-119b of the Overhaul Manual.

Very resp'y,

Headmouse

Glass Jar Hazards

Dear Headmouse:

Canopy polish, Mil-C-19767B is dispensed in glass bottles. I have observed several instances in which plane captains accidentally dropped these glass containers causing serious FOD conditions and imposing personnel injury hazards.

It is suggested that this polish be provided in plastic containers similar to those used for liquid soaps.

MIRAMAR MOUSE

Your suggestion appears to have merit. It is being forwarded to the appropriate authorities for consideration. In the meantime, readers may like the idea and put the polish in such containers. It is recommended that whenever this is done that the container be thoroughly cleaned to avoid contamination and relabeled as to its new contents to prevent misuse.

Very resp'y,

Headmouse

Canned Water

Dear Headmouse:

Flying from this station is mostly over land with hops that could qualify for desert, semi-desert or mountainous terrain classifications. The seat pan of the aircraft in question, however, carries a desalting kit, a solar still, a corner reflector, dye marker, shark chaser, etc., but no cans of survival water. Official channels were tried but the answer was "too expensive." Expense doesn't strike home as sufficient reason for omitting a vital survival requirement, particularly when the need for the sea survival kit is almost zero. These birds are strictly land-based.

MONTEREY MOUSE

▶ Final decision on this question is up to your commanding officer. One local parachute rigger recalls he was prepared to remove the solar still and desalting kit temporarily and replace them with canned water when his squadron deployed to Yuma.

Very resp'y,

Headmouse

Flight Deck Crew Vests

Dear Headmouse:

In the July '65 issue you reported evaluation tests of life vests for flight deck crewmen were underway. Please post us on the outcome of these tests and when these flotation garments will become available, if at all.

SEA-GOING MOUSE

Jacket type flotation garment scheduled for flight deck crews.

▶ Evaluation tests were completed September 1965 with fleet acceptance of the jacket type garment with minor improvements. NASC forwarded recommendations for procurement by quantities, colors and sizes to CNO. CNO directed BuShips to procure and issue jackets at the earliest practicable date. BuShips has indicated procurement and outfitting will be expedited. Jackets will become available through the Federal Supply system.

Very resp'y,

Headmouse

Pistols With Tracers

Dear Headmouse:

. . . either vindicate me or I'll grudgingly admit I was either the 10 percent who didn't get the word or got it garbled. But, Headmouse, please help!

It's now a normal part of my preflight flight-gear inspection to load my revolver and strap on the whole rig: revolver, lanyard, shoulder holster and 'bandolier' all go on under my flight-jacket and/or mae west. But, Headmouse, if you could only guess the amount of ribbing I've had to take about that gun! The skipper asks if I'm going out to fly or hunt coyotes (". . . or both?"); the safety officer wonders if this is my idea of discouraging midairs (". . . put a shot across their bow, and all that?"); the avionics officer inquires about a "new method for contacting the tower in event of comm failure?"; and, as I finally attempt to withdraw unobtrusively from the ready room, the schedules officer loudly administers the coup de grace, assuring me he'd be more than happy to set me up for a gunnery hop! (in an H-34?!) and on and on. . . . All because I think I'm doing a wise thing, too. . . .

I thought our SH/UH-34 NATOPS or OpNav would mention something about pilots carrying pistols for signaling but I've not been able to find a word. Your help would be appreciated.

"WYATT EARP"

▶ Your answer is in OpNavInst P3710.7B, 827.g: "All crewmembers in combatant aircraft and single-engine training aircraft shall carry a pistol with tracer ammunition for all night flights, and for all flights, night or day, over water or sparsely populated areas. An approved signaling device is authorized as a substitute for the pistol when operational and/or security conditions warrant. The carrying of such an approved signaling device in all other Navy aircraft is encouraged."

Very resp'y,

Headmouse

Dual visors—tinted and clear.

Visor Problem

Dear Headmouse:

One of the most indispensable pieces of a pilot's flight equipment is the helmet. It has, no doubt, saved numerous lives and protected even more pilots from serious injury. The helmets in use today are excellent protection with one frustrating exception—the visor. I know of several Aircraft Accident Reports recommending that a visor capable of quick change from dark to clear lens be designed and issued to the fleet. I have read countless instances in Safety Center periodicals wherein a distressed pilot could have made excellent use of a visor, were he able to see through it. Visibility conditions change drastically during the process of many flights. The dark visor in use is excellent on bright days (if it is bright from takeoff to rollout) and the clear visor does well at night (if you don't pass a bright area and intend to retain your night vision). Why not two visors per helmet?

It there a solution in the near future?

T. L. ELSER
ASO, MAC 31

▶ At a recent equipment symposium attended by NASC representatives, a well-known equipment manufacturer demonstrated a new helmet dual visor installation. (See photo.) This idea involves a visor track on each side of the helmet in a fiberglass housing. One button operates the clear visor and the other the tinted visor. The wearer can use one visor at a time or both at the same time. According to the manufacturer, the kit can be adapted to the APH-5, the APH-6/6A and the APH-7 helmets. (In order to show both visors clearly in the photograph, the inner lens is raised slightly above its normal full down position.)

As of this writing, there is no indication as to whether the Bureau of Naval Weapons will approve this design but the Bureau is considering it.

Very resp'y,

Headmouse

Squadrons operating several breeds of airplanes have a unique safety problem. Here's how one composite squadron tackles the problem with . . .

The Series Leader

Within the naval aviation organization there are many commands which differ from the ordinary fleet squadron because they are custodians of more than one particular series of aircraft. Some of them operate different models within the same basic classification, such as transport squadrons (ie. C-54P, C-131, C-54Q, C-54S, C-118). Others operate widely diversified models within several or even all basic classifications, ie: A-1, A-4, C-1, F-8, P-2, P-3, S-2, such as in composite or ferry squadrons; or test and evaluation activities. Although this article is concerned with a composite squadron, a good deal of it is adaptable to any organization where pilots must be qualified in several series and models of aircraft.

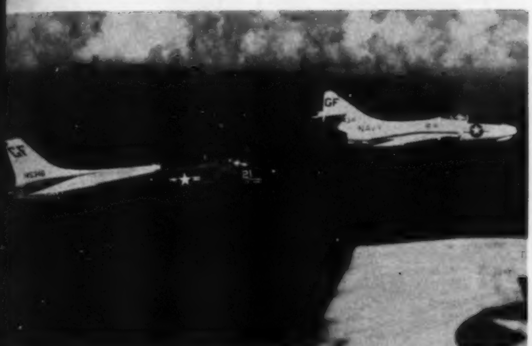
In a composite squadron the ASO's main problem is as in any squadron—pilot factor. The problem of habit pattern transfer or carrying over past learning is a hazard that must be reckoned with. For example, I recently attempted to start an F-9 with a throttle crank due to habit pattern transfer from the F-8 when in fact, the crank switch is separately located. Another pilot, qualified in F-8, F-9 and T-28's landed an F-8 with the speedbrakes extended. Although this is permissable in the F-9 and T-28, in the F-8 it isn't.

Problems also exist in pilot judgment of aircraft attitude, altitude, and speed when pilots are currently qualified in dissimilar models where the cockpit environments are radically different. For example, pilots flying the P-2 report difficulties accurately gauging the flare point during landing after several landings in another aircraft with shorter legs. Helo pilots for instance have reported several judgment difficulties flying fixed wing aircraft. A tendency exists to overshoot the runway when turning final due to the wider turning radius and a desire to commence the landing flare somewhat high—about 200 ft as in entering a hover. An occasional blown tire or wrinkled wing attest to the hovering capabilities of a fixed wing airplane.

All of these pitfalls must be collected and passed on.

Frequently, we are reminded that the ASO should attempt to be the best qualified and most learned pilot in the squadron in order to set the example that any safety program deserves. However, how can he be an

By LCDR D.T. Pitts, ASO, VC-8



expert or set the example when he is qualified in as many as four or five different aircraft models? Is he a jack of all trades and a master of none? How can he collect all the pitfalls of habit pattern transfer or past learning and pass it on to those who need to know about them.

The answer in my squadron is found in the Series Leader program. Under this program, the ASO retains overall responsibility for running the safety program; however, he has an appointed assistant for each series aircraft assigned called Series Leaders.

The Leaders are selected on the basis of seniority, experience in the particular model that they will be experts in, mature judgment and, in general, the same basic qualities desired in an ASO. For emphasis, their billets are treated as primary and each is, in effect, a Safety and NATOPS Officer.

The Leader is responsible for the standardization of all pilots flying his aircraft, maintenance coordination, supervision of the flight training syllabus, and frequent meetings to bring current information to the attention of all pilots and for mutual discussion of problems arising within the series. While the ASO should attempt to be qualified in all models assigned, he attends meetings of all models whether qualified or not, and the agenda of these meetings are submitted to the commanding officer in order to further formalize the program.

In a composite squadron, pilot, aircrew and ground training emphasis must be unusually intense and concise. Since a pilot may be required to be familiar with perhaps as many as three different ejection seats with varying survival equipment, proficient in both high and low altitude instrument procedures, qualified in the different phases of the command's mission, etc., the definition of just what a pilot must accomplish in order to be considered current in model must be clearly defined.

Since missions are frequently assigned that require procedures outside the scope of the NATOPS manual, standard operating procedures are called for as an extension of NATOPS—with emphasis on the safe accomplishment of the assigned task. Detailed briefings together with a review of emergency procedures immediately prior to a mission are priority items tending to reorient a pilot's thoughts towards the particular model.

The ASO in a composite activity has an exceptional challenge requiring command attention, versatility, and unusual assistance. A Leader program is a part of this assistance and injects the necessary attention to detail so vital to a successful specialized safety program.

The Leader program has been very successful in VC-8 and is highly recommended for a command that has a similar safety requirement.

This is an updated version of an article which appeared in the December 1958 APPROACH.

BACK IN THE HARNESS

Christmas leave with the wife and folks had been real great this year—all 13 days of it.

Up home, the weather had been crisp and cold, just right for the holidays. Back at the air station, you had to look at the calendar to tell it was December 28. The thermometer by the swimming pool was registering a pleasant 68°.

The LTJG had stretched his leave out to the last minute to stay at home as long as he could. December 27th he slept until noon, spent the afternoon quietly and ate dinner with the family. A few hours later, he left for the municipal airport to catch a southbound commercial flight departing at midnight.

As the big airliner droned through the black winter night, the young officer managed a couple of hours of fitful sleep. The plane put down at its destination at 0330.

Taking a taxi to the naval air station, he logged in with his squadron duty officer at 0400, then sacked out in the readyroom for a few more hours' sleep. At 0715, he got up, ate breakfast and mustered with the squadron.

When he reported to the squadron flight officer, he was reminded that he was not required to fly on the day he was returning from leave. It was established policy that individual pilots could fly or not fly, relative to their physical and mental condition, no questions asked. However, if the pilot felt ready, the flight officer said, he could make a FAM flight (required of all squadron pilots returning from extended leave) and if he chose to do so, practice loft bombing maneuvers in the afternoon.

The pilot elected to fly.

For the morning FAM flight, he took the aircraft up for an hour-and-a-half to practice loft bombing maneuvers. As the squadron's special weapons officer, one of the last things he had done before going on leave was to lecture squadron pilots on the correct technique for making a loft maneuver.

While he had been on leave, a new instrument had been installed in the aircraft, the first piece of this gear available to the squadron. In conjunction with his billet as special weapons officer, the LTJG used part of the morning hop to familiarize himself with the new equipment. In the readyroom after the flight, he commented that when using the new instrument he had experienced some difficulty recovering from the loft maneuver.

On the morning hop, he completed a known minimum of eight loft maneuvers at altitude, each designed to pull $4\frac{1}{2}$ G.

Flying the same plane in a flight of six aircraft on the afternoon hop, the pilot launched early to make additional practice runs at altitude before going on target. He is thought to have performed four more loft maneuvers.

The first group of three planes completed their runs. After rendezvous, each pilot in the second group of three made a low pass over the target run-in course for familiarization with the target area. The flight leader then pulled up and began and completed his run. The no. 2 man came in over the course and aborted.

Flying in the no. 3 spot, the LTJG called in at the 180 degree position and began his run. He did not call at pull-up and consequently was not observed in the initial part of the maneuver. He was first seen spinning to the left at 1800 ft, coming straight down. The plane crashed approximately 200 yards from the pull-up point, exploded on impact and burned.

According to the Aircraft Accident Board's report, a contributory cause of this accident was the pilot's fatigue (five hours' broken sleep in the last 27 hours) which had lowered his G-tolerance. The newly installed equipment which he may have elected to use on the bombing hop was thought to be involved in some manner but the lack of evidence due to the fire and the lack of witnesses to the first part of the fatal run made a final determination impossible.

Pilot and crew fatigue is a most important problem in naval aviation.

Fatigue has many causes and takes many forms . . . the fatigue of a weekend warrior who drives long hours in heavy traffic to reach his duty station and is tired by the time his flight takes off . . . the young carrier pilot who lives it up on leave to the extent that he comes aboard ship with a backlog of fatigue at the beginning of weeks of intensive flying . . . the fatigue of a transport crew on the last leg of a Pacific flight from Midway to Tokyo.

Because of the large number of intangible and variable factors involved in pilot and crew fatigue, there can be no yardstick for its measurement. Fatigue is a matter primarily for the individual airman and his flight surgeon.

What is fatigue?

Armstrong in *The Principles and Practice of Aviation Medicine* says: "The word fatigue is an inexact expression used to describe either a feeling of weariness or a diminished capacity for doing work, or both, generally as a result of previous activity. However," he continues, "even in the absence of previous work, fatigue may be complained of, proving that it may

arise from purely psychic or emotional stresses."

Psychic and emotional stresses are generally considered significant causes of pilot and crew fatigue *since fatigue in aviation personnel is out of proportion to the physical exertion involved.*

"As psychologists have long recognized, fatigue is an ambiguous and slippery concept," R. L. Thorndike states in his study for the Air Force, *The Human Factor in Accidents.* "It has been approached from at least four different angles by different workers. Interest has at various times centered upon (a) subjective feelings of tiredness, (b) physiological and chemical changes after continued work, (c) decrement in performance after continued work, and (d) boredom and loss of willingness to continue with a task.

"These different aspects (of fatigue) are related to one another," Dr. Thorndike continues, "but not in any simple or direct fashion. All the features depend to some extent upon the length of time that an individual has engaged in a task, but many other factors also enter in, so that the number of hours an individual has been exposed to a task cannot serve as a measure of the degree of his fatigue. For example a British researcher found that out of 16 factors rated, British bomber pilots placed the following five first in order as producing their (subjective) fatigue:

1. Formation flying
2. Flying two consecutive nights
3. Bad weather
4. Strong enemy opposition
5. Long flights

Thus, the length of a particular session of flying ranked no higher than fifth on the list."

Fatigue can be either temporary or chronic. Temporary fatigue or normal tiredness is completely relieved by a good night's sleep. Chronic fatigue is not relieved by a normal night's rest. It may be characterized by one or more of the following: increased tension, reduced aggressiveness, irritability, loss of appetite, lowered individual morale and insomnia. Combat fatigue is an extreme state of chronic fatigue which occurs in operational flying. Additional symptoms include abnormal fears and tremors.

Generally speaking, the three main causes are physical stress (from outside the individual) such as heat, noise and vibration; physiological stress (from within the individual) such as hypoxia, lack of sleep, poor physical condition; and emotional stress (from without and within) such as boredom, anxiety and fear.

*Williams, G. O., *Fatigue and Flying Accidents,* Flying Personnel Research Committee, London, 1942, No. 492.

What are the effects of fatigue in flyers?

The effects of fatigue include such physiological phenomena as lowered physical efficiency, reduced night vision, increased susceptibility to vertigo and decreased G-tolerance. Subjective symptoms are increased irritability and increased awareness of physical discomfort. The degree of fatigue experienced is determined by the individual's tolerance to stresses, the amount and duration of exposure to stress and the influence of group morale. The fatigue impact of a stress situation is lessened for the individual when he knows others in the same situation are experiencing similar feelings. Good personal and group motivation can increase resistance to fatigue. Fatigue is more significant in flying personnel than in the general public because in flight there is less margin for human error.

Fatigue results in the *unconscious* lowering of performance standards, a state of affairs sometimes referred to as skill fatigue. According to the *USAF Flight Surgeon's Manual,* characteristics of skill fatigue in pilots and crewmen are:

- Requirement of greater than normal stimuli to produce the appropriate responses.
- Errors in timing of movements involved in a larger operational sequence.
- Overlooking of some important elements in the task sequence.
- Loss in accuracy and smoothness of control column and rudder movements.
- Unawareness of accumulation of rather large error in azimuth, elevation and attitude.
- Increase in control movements involving greater fluctuation in order to produce some effect.
- Undercontrol and overcontrol of movements.
- Occasional forgetting of side-tasks.
- Increasing unreliability of reports of what transpired.
- Errors of inattention.
- Increasing "stickiness" or fixation of attention in which the pilot becomes preoccupied with some one part of a task to the exclusion of others.
- Allowing various elements of the operational sequence to appear out of place with respect to one another.

There are some situations in which a person has to fly when fatigued. In this respect, it is well to remember that fatigue does not lower an individual's knowledge of how to perform a task; but it decreases his will to do the task and thus results in inattention and increased accident hazard.

However, as Dr. Thorndike points out, the fatigued

individual who is sufficiently motivated is quite successful in mobilizing his powers for brief critical periods. The few moments during which a landing is accomplished represent such a brief critical period.

What can be done to increase one's resistance?

The individual airman can do a number of things to help himself:

1. *Get plenty of sleep*: Though in itself, the loss of sleep may not be decisive, combined with other stresses of factors (as in the case cited at the beginning of this article), it can be of great significance.

2. *Maintain good physical condition*: Vital factors are proper diet, exercise and recreation, and in smoking and drinking habits, moderation.

3. *Wear and use personal safety equipment properly*: The G-suit reduces fatigue by assisting circulation. To further counteract fatigue on flights above 10,000 ft, strict oxygen discipline should be observed.

4. *Vary the old routine*: Small things such as getting up and turning around can help shake off fixedness and rigidity which can tire the airman. If the pilot can't get up from his seat, he can reduce fatigue by stretching, by opposing his muscles or by walking his toes inside his shoes. Minor diversions such as eating an apple or a candy bar, drinking fruit juice or even, as one authority suggests, singing can break the monotony and counteract boredom.

5. *Take measures to prevent dehydration and hunger*: Dehydration can be alleviated by adequate liquids and salt intake. Snacks will fix those hunger pangs.

6. *Realistically and objectively evaluate your condition and ability to fly*: A man mature and responsible enough to be a part of naval aviation will exercise good judgment in deciding if he is fit to

fly. Be frank with yourself and when in doubt consult your flight surgeon. He is in an ideal position through experience, knowledge and examination and observation of individual cases to help you.

Many other persons in the field of aviation and in related fields can help reduce flying fatigue.

Research men and designers can make a great contribution through work on clothing and personal equipment, seats, controls (their direction of and resistance to movement and their location), instruments, cockpit lighting, control of cockpit pressurization, humidity, temperature and ventilation, and reduction of noise and vibration. Work is needed on the layout of controls and instruments at individual stations and in the integration of individual stations in the overall arrangement of aircraft flight decks.

Maintenance workers can lessen the airman's apprehension by high standards of maintenance and repair of equipment which increase his confidence in the aircraft's mechanical reliability.

Administrative personnel can draw up well-planned flight schedules allowing pilots and crews plenty of time for meals, sleep and breaks between scheduled activities. This is especially crucial in student pilot training. Maintenance personnel should be given ample time to do a thorough and competent job. In establishing realistic flight and maintenance schedules, extremes of temperature and humidity should be taken into consideration.

The pilot's or crewman's family can help provide a happy home life, free as possible from emotional conflicts, tension, worries and disturbances. An airman's morale is a key factor in his resistance to fatigue.

Through his understanding of the problems involved and his knowledge, examination and observation of the individuals under his care, the *flight surgeon* can make an important contribution to lessening the accident potential of fatigue.

And, finally, *flight leaders and senior officers* all share the responsibility with the flight surgeon and the pilots and crewmembers, themselves, to maintain a close watch and temporarily ground anyone suspected of being "too tired to fly."

A visit to pilots on carriers of the seventh fleet operating against Northern Viet Nam by three experienced flight surgeons in September 1965, for the purpose of evaluating fatigue brought forth the fact that there does exist a measurable amount of it, that it is essentially in the psychic and emotional stress area and that despite this fatigue, performance has never been better. The sole degradation which could be found lay in the disturbance of the basic morale elements. No psychoses or neuroses were found. No increased "sick-callitis," no "planedowning," no decrement in professionalism was observed.

Recommendations were made to Chief of Naval Operations which were calculated to reduce the degree of stress without diminishing the effectiveness of each pilot. Some practical conclusions based on objective evaluation of subjective pilot and supervisor impressions have emerged from the visit.

Safety Measure

The following is part of the 1st endorsement on the AAR on the accident described at the beginning of this article:

"It has been the policy of this command that individual pilots have the prerogative of flying or not flying when it is relative to their physical and mental condition and with no questions asked. Senior officers and flight leaders are also on the alert for the obvious cases. Much effort had been made to impress upon the squadron pilots the necessity for proper physical conditioning and to properly and strongly indoctrinate pilots in all measures of safety. The high rate of accidents during the holiday seasons with particular reference to the loft maneuver had been emphasized personally by this command just prior to leave periods and all hands were on the alert to prevent such accidents. It would seem that the responsibility of one's own life would be adequate safeguard against this important and vital factor of fatigue. However, as long as we have eager and conscientious young pilots, this will continue to be a problem.

"This command will continue its present policy of individual responsibility for flying, and flight leaders and senior officers have been directed to maintain a closer surveillance of junior pilots and unreservedly ground anyone even suspected of being either emotionally or physically unfit for flying. It is felt that this will be an easy task in this particular command due to the extremely costly lesson learned by the death of LTJG ————. In other commands, constant curbing of the eagerness of young pilots to fly at all times under all conditions must be a continuing concern of all responsible officers. The mere asking of an individual of his physical condition and allowing him to make the decision is not enough."

Hear Ye! Hear Ye!

THE main reason for recording an audiogram on the flight physical is to determine the probability that radio transmissions can be heard. The audiogram is the hearing test performed in the soundproof booth and is required every third year. BuMed requires testing only in the range of speech frequencies.

A secondary, but very important objective of our audiogram is to detect early hearing losses in the high frequency range and thus take steps to prevent further loss. If a high frequency hearing loss caused by noise is caught early, further loss can be aborted.

The Navy requires the recording of hearing for Service Group I Aviators and NAO(I)'s between the frequencies of 250 cycles per second and 2000 cps. We include measurements up through 6000 cps. The Rudemose audiometer is an accurate and sensitive machine which produces pure tones of various intensities, with the intensity heard by an "average" ear automatically recorded as zero decibels, a decibel or db being a measure of sound intensity.

If more than the average intensity is necessary before being heard, a "plus" score is recorded, i.e. how many decibels greater than the average is required. A "minus" db score indicates that less than average sound energy is required for hearing at that frequency and is, therefore, better than average. An audiogram tracing that falls between —15 and +15 is considered *"normal."* If a loss in the speech frequencies (300 to 3000 cps) is greater than 30db, difficulty in hearing the spoken word can be expected.

The Aviation Standards for Service Group I are: a maximum loss of 20db between 250 and 2000 cps in the better ear and a maximum loss of 40db in the poorer ear. Complete deafness in the higher frequencies is not disqualifying because radio transmissions will still be heard. (In cases of high frequency deafness, the pocketbook is also a big loser if it is emptied to buy exotic high fidelity stereo equipment that can never be appreciated.)

Being continuously subjected to noise hazards tires the hair cells of the snail-shell-shaped cochlea in the inner ear. Tired hairs can recuperate many times, but eventually they become so stressed that they fail to perk up again. When this happens the hearing nerves at the hair roots cannot transmit sound impulses to the brain and deafness is the result.

Deafness caused by noise first becomes apparent at the higher frequencies and the dip in decibels that occurs at high frequencies is called "aviator's notch." This is the warning signal that heralds the onset of progressive deafness unless steps are taken to prevent noise exposure.

Naval aviation seems to be a "deaf-trap." Much exposure to jet and prop noise is compounded by habitation on a carrier where the screams of engine turn-ups, the screeches of arresting gear, the thunderous claps of chocks hitting the deck, and the innumerable squeaks, clangs, and clanks of steel against steel harass the most formidable of hair cells.

If you frequently say "Huh?", "What did you say?" or "Say again, please!" and have determined that the speaker is not a mumbler, better question your flight surgeon. If he says you have an "aviator's notch" better use noise suppressors to prevent further damage. Better yet, don't wait! Carry earplugs with you aboard ship and around the hangars, so that you can pop them in when a noise blast comes your way.

—*Lt Ronald J. Amalong, MC*

Does any member of your crew have consistent trouble in survival training?

BLACK

On signal from the catapult officer, the F-4B pilot advanced both engines to full military power and checked engine instruments. He told the RIO he was ready in the front cockpit and asked if the RIO was ready to go in the back. His answer was affirmative.

"Here we go!" the pilot said when the catapult officer signaled for the shot.

The catapult shot was normal with an excess end speed of 16 knots. Immediately after launch, the aircraft failed to gain altitude and impacted with the water in a wings level attitude.

"I had the sensation immediately after the shot of just hanging in space and not going anywhere," the pilot recalls. "The aircraft never really seemed to be flying although I am fairly sure it was not stalled.

"The aircraft struck the water sharply—there was a pause in the deceleration forces as it seemed to skip, then it struck the water again and decelerated rapidly to a standstill. I had not pulled up my landing gear or, in fact, even taken my hand off the throttles until after hitting the water.

"After the initial impact, my RIO said, 'Pull up.' I replied, 'Eject!' During the deceleration, I was quite conscious of the violent side-to-side force as I was thrown about the cockpit. Sometime before the aircraft came to rest in the water, the windscreen quarter panels broke, allowing water to come in from the front. I did not have my helmet visor down at the time (although the incoming water presented no problem a visor would have been able to solve).

"Electrical power was lost as the aircraft entered the water. I therefore had no communications with my RIO from that point on as I retained my oxygen mask and could not yell at him.

(The RIO was never found. It was the conclusion of the aircraft accident investigation board that the RIO "was alive and conscious after the aircraft came to rest in the water, that he jettisoned his canopy, erroneously removed his oxygen mask and possibly his helmet, and was unable to effect an egress from the aircraft due to unknown factors." Endorsers to the accident report were divided in opinion on the board's conclusions.—Ed.)

"When the aircraft came to rest," the pilot continues, "I moved the normal canopy actuator lever to the open position. This did not work. I then pulled

both the canopy emergency unlock handle and the canopy emergency jettisoning handle. The latter blew the canopy clear of my cockpit. I did not see where it landed. A few seconds prior to my canopy jettison, I heard a sharp crack that sounded as though the rear canopy had been jettisoned pneumatically. I saw no flash of light indicating an explosion associated with this noise.

"During the deceleration after the second impact, I noticed a tremendous amount of phosphorescence in the water. Its brightness provided adequate light to see until the aircraft stopped. I also felt as though the aircraft definitely sloughed to starboard.

"Once I had jettisoned the canopy, I pulled the ejection seat guillotine handle in order to free myself and the parachute/seat pack from the seat. The seat pack came loose with very little effort. The parachute pack, however, became hung up, I believe on the horn it is mounted on although I cannot be sure on this point. In the meantime, the cockpit and I had gone under water. I released my shoulder rocket jet fittings and with moderate effort succeeded

NIGHT

in clearing the cockpit with the seat pack. Once clear, I inflated my Mk-3C flotation gear and came to the surface." (The sea was calm with little wind. Surface visibility was good but the night was very dark.)

"The empennage of the aircraft was just above the surface about 40 ft away and indicated the aircraft was in about a 40 degree nose-down attitude and sinking rapidly. I estimate that total time from cat shot to ditching was on the order of less than 10 seconds and from that point to the time I reached the surface clear of the plane was about two minutes.

"I immediately called several times for my RIO but received no answer. By this time the ship was abeam of me so I fired two tracers into the air from my .38 pistol spaced about a half-minute apart. A few minutes later, I saw several ships' lights converging on my general area, so I fired another tracer round. When it became apparent one of the destroyers had located me with a searchlight, I fired one more round, then turned on my red flashlight and pointed it at the destroyer. (*The pilot had his strobe light but the batteries were dead.*)

"Shortly afterwards, a swimmer from the destroyer reached me, bringing with him a horse collar type flotation gear. He helped me into it and attached a line from the ship to my torso harness. They towed me to the ship and I was brought aboard without further incident.

"Later in talking with the skipper he indicated that they were able to locate me initially by the tracers and when they were close, by my red flashlight (which the ship's personnel mistook for a flare). He also mentioned the reflective tape on my helmet was visible while the ship was still a good distance away. Once in the direct beam of the searchlight, my orange flight suit was quite brilliant, he said.

"I was in the water a total of 10 minutes."

* * * *

According to the investigating flight surgeon, classmates of the RIO recalled after the accident that he had experienced difficulty with the Dilbert Dunker in flight training and seemed to panic underwater. He twice had to be pulled from the Dunker by the diving observer and required seven tries to finally make a satisfactory underwater escape. The pilot had been "a scuba diving enthusiast for years."

Ready To Survive?

An aviator starts surviving even before he steps out of the ready room and continues to practice survival everywhere, from the open sea to a POW camp, to being rescued and returned to his ship.

How do you tie your shoe laces? Are they sloppy with a big bow or is as much slack as possible taken out by wrapping the excess string around the ankle? Is your hardhat sturdy and able to resist a blow, or has it possibly been weakened by being dropped on the deck? Knife in good shape? Take a look. You might just be surprised.

Your boots and your knife are the most important survival items you have during a survival on land situation.

How about that flight suit? Are you confident that it will still resist a fire? You should be. After all, that flight suit protects you, not the other guy.

We've all heard the old saw that survival equipment is only as good as its user; well, just how good is the user? Do you take that long, cool drink of water before flying in hot weather so that you'll be able to maintain that peak of efficiency? How's your physical condition or perhaps I should better say, "How did you feel after your last PT test?" Are you still a strong swimmer, or have you allowed yourself to go downhill because of the cold water and the "uselessness" of splashing around in the pool? And most important, do you know your survival equipment, or do you expect a message in the form of a lightning bolt to give you knowledge after you're all alone and on your own.

If you've answered "no" more than twice, STOP, and take stock; you're skating on thin ice. Even if you've answered "yes," you must still constantly relearn your escape and rescue procedures. If you have everything else going for you you will still have to exert the old will-power and self-discipline to remain calm, avoid panic, and think ahead.

Notes from your Flight Surgeon

Did you know that even when you have it "made" you still must be rescued, and being rescued can, and possibly will be, the most hazardous portion of your sojourn away from home?

—Dale E. Haan, LTJG, HC-4

Ye Gods!

'AN S-2F crew became ill from possible CO poisoning. After returning to base they neglected to down the aircraft or report to sick bay. The plane was recalled from the next flight for close inspection when the incident was finally discovered. *The crew did not want to down the aircraft as only a limited number of planes were available for week end flying!'*

—Safety Council

Mental Set

MENTAL or psychological "set" can be thought of as being derived partially from the personality of the individual, a natural component, and partially from learned behavior, an acquired component. A training program for any profession must accentuate the only component which it can possibly affect: the learned portion.

By so doing, perhaps more stress can be laid upon development of an alert, thoroughly professional attitude in the neophyte aviator. Adequate sleep, moderation in strenuous extra-curricular activities, and generally admirable health habits also need some stressing, but in the well-motivated, well-qualified individual with the appropriate mental set, these all tend to fall into place naturally and without stress.

—Flight Surgeon in MOR

Fumes and O_2

A HARD carrier landing by the pilot of an EA-1F resulted in a bolter followed by a hook skip bolter and final landing.

After the first bolter the crew smelled hydraulic fumes. The fumes were so concentrated in the rear cockpit that the crewman became lightheaded and later reported he had a "strong urge to throw up."

Because the barrier was being rigged, the LSO advised that the canopies be kept closed per squadron policy. The pilot feared oxygen might cause a fire if combined with vaporized hydraulic fluid so he told the crew not to use their oxygen masks. (*This was in error. This kind of situation calls for use of 100 percent oxygen.—Ed.*)

ACSEB 7-54 states, "Whenever . . . excessive carbon monoxide or other noxious or irritating gas is present or suspected, then regardless of the altitude, the valve shall be set to the 100 percent oxygen position and thus undiluted oxygen will be used until the danger is past or flight is completed.

"Widespread confusion exists in that some flight personnel fear that using 100 percent oxygen in the presence of oil, gasoline or hydraulic vapors sets up a dangerous explosive situation," the investigating flight surgeon states. "However, the setting of 100 percent oxygen creates a closed circuit oxygen system which excludes cockpit air and fumes and disseminates no oxygen unless there is an oxygen system leakage. Again it must be recommended that fleet indoctrination continue through current efforts of squadron personnel and flight surgeons."

All pilots and aircrewmen in the command are being briefed to use oxygen when unusual fumes of any kind are determined to be present in the cockpit, the report states.

Thumb Rules

EXCEPT as permitted in transport aircraft, life preserver equipment shall be worn or carried as required on any flight which operates over water and outside of safe gliding distance (no power) to land. Jet pilots should consider, in addition to aircraft gliding capabilities, the effect of wind on a parachute ride from at least 13,000 ft altitude. Thumb rules which fall well within these requirements follow:

1) If you can't make land in a no-power glide—wear it.

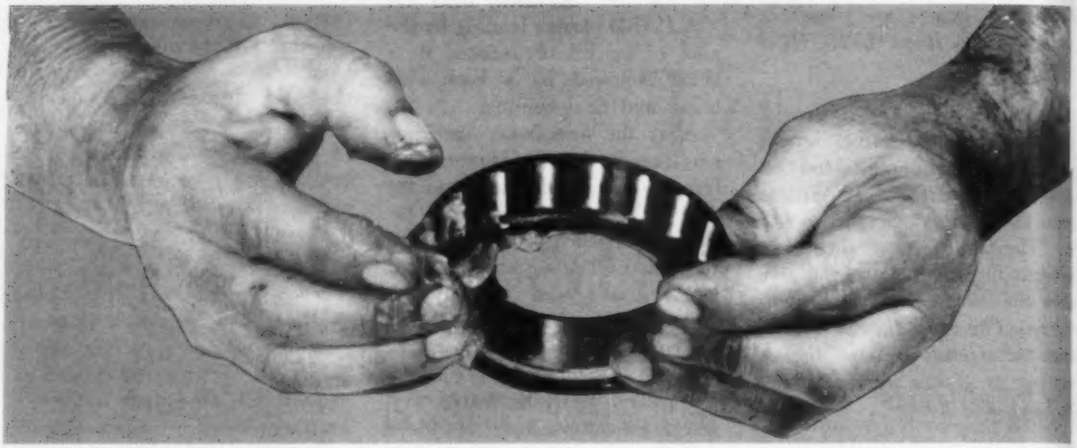
2) If you *think* you can, have it handy to wear when you first find out you can't!

3) If contemplating a parachute ride—crank in wind drift and a need probably will be found for a life preserver on just about every flight out of (this particular base) that does not go west immediately after takeoff. Drownings are a common warm weather occurrence even in our own back yards. Why? A lack of preventive precautions taken!

In flying as in medicine, one uses past successes the best indication for a particular course of action.

—Flight Surgeon in MOR

BEARING CARE



Perhaps one third of all the questions asked concerning ball and roller bearings involve lubrication. "What do I use?" "How much do I need?" "How often do I service?" Information concerning lubricants and associated problems would fill a book, but this article will be limited to some basic do's and don'ts, and some tips on how to get more bearing service life through adequate lubrication.

We'll start by dividing lubricants into two categories—oil and grease. Oil is by far the best bearing lubricant if there is a proper oil pump and system. In general, properly oiled bearings will carry heavier loads for longer periods than greased bearings. That is why an engine incorporates an oil system for lubricating the main bearings.

Of course, oil systems have problems. They get dirty and pick up water and acids. Sometimes they leak, or system components break down and oil filters become clogged. So—service the system and check the oil levels at regular intervals. It's a good idea to rub some of the oil between your fingers when it is checked (but be sure your fingers are clean). Abrasive grit can be detected with a finger-rub before it is visible to the eye.

The oil should be changed regularly, using the manufacturer's recommended type, quantity, and service interval. Good men were paid a lot of money to come up with the answers. Deviations from the recommendation can be made, but only when problems arise or when carefully kept records show that changes can be made. There are probably some oils that can do a better job. But there are a lot more that can't.

The second category is grease. Even though oil is best for bearings under loads, grease has certain advantages that have been responsible for its extensive use. The primary advantage is obvious—there is no reason for a lubrication system. In aircraft, where weight is such an important consideration, grease ball and roller bearings are used extensively. No pump, filter, oil tank, or oil line is required. You just slap a little grease on the bearing and forget about it. Or do you? Let's hope you don't. Greased bearings have four basic problems—type of grease, amount, life, and contamination.

Grease type is important. Many types are available—high temperature, low temperature, light, heavy, medium, long life, heavy load, and many variations in between. Grease consists of oil and an oil carrier. The oil carrier (soap) gives the grease its color and consistency, but the oil (sometimes it puddles in the top of the grease cans) actually lubricates the bearing.

There are many types of oils and just as many, if not more, soaps used to make the different types of greases. And scientists keep making new synthetic oils and soaps to add to the confusion. Therefore, Rule No. 1 in bearing lubrication is: "Do not mix different types of grease in the same bearing."

A mixture of different types of grease can cause

corrosion, provide no lubrication at all, or cause a jammed bearing, to name but a few of the evil results possible. There have been cases where two different greases, manufactured to the same specifications, were combined in the same bearing and caused trouble. So, when grease is replaced, clean the bearing thoroughly. When grease is added, be sure that it is the same kind.

Too Much Grease?

Can a bearing have too much grease? Yes, indeed! It is not uncommon to have a bearing fail through overheating. The grease will churn and excessive friction will overheat the bearing, especially if there is minimum clearance between the shields and the raceway. The excess grease can also contaminate the surrounding area and cause a malfunctioning of another unit.

In most cases, this condition is easy to check. Slip the bearing onto an electric motor shaft, a mandrel, or a lathe chuck. Hold the outer race while the inner race is rotated to spin excess grease from the bearing. This procedure is known as "channeling." The grease is moved to the side of the ball path so that it is close enough to allow proper lubrication of the balls by means of oil seepage, yet it is far enough from the balls to avoid churning. The average bearing is about one-third full of grease when properly greased in this manner. Remove the excess grease with a clean rag or paper wiper. Care must be taken to not contaminate the bearing. Do not install the bearing if the torque cannot be reduced by channeling, as could occur in the case of a tightly sealed bearing. Remember, it is better to have too little rather than too much grease.

Rod-end, airframe, and control bearings are too often abused as far as lubrication is concerned. Many people consider it easier and quicker to change the bearing, and others think of these bearings as being permanently lubricated. Nothing could be further from the truth. Think of these bearings as you would a car. You lube your car every 1500 miles or so unless it has the new 30,000-mile system. Regular lubrication reduces wear and extends the time period before replacement is required.

Oil and grease cans should be kept closed when not in use, and should be opened only in the cleanest areas available. Use clean, lint-free cloths or wipers on the bearing or lube equipment, replace the bearing lubricant as often as is practical, and avoid excessive grease packs. Follow these tips and you can look forward to longer life and greater reliability from ball and roller bearings.

More specifically, contamination can come from several different sources, such as:

- Not clearing the grease nipples before greasing.
- Not keeping grease guns clean.
- Not covering grease containers.
- Using dirty implements.
- Debris from another job, such as cleaning, scraping, or sand blasting.

Debris, especially the abrasive type, can do untold damage. In bearings used in high speed applications, abrasive debris can cause excessive wear and ultimate failure of the ball retainer. In some cases the balls are worn out of round, causing the equipment to vibrate. When two bearings operate as a matched pair, they are susceptible to special problems. Quite often a matched pair will be operated in such a manner that the balls will not spin as they rotate. Abrasive debris can cause a heavy path to form on each ball. Then, when something causes the ball to spin, the new operating paths will cross the old paths. Rough operation, vibration, and ultimate failure are the results. In some cases, abrasive wear has been known to wear the ball down to the point where the bearings fell apart.

Important Problem

One last important problem—that grease rag. Interestingly enough, grease and oil themselves are treated as dirt. No one likes to work with greasy or oily hands; You simply endure it, or maybe you are used to it by now. Grease and oil seem to have a natural affinity for dirt.

Take another look at your grease rag. Maybe you remember the oil dampened cloth Grandma used to keep for dusting the parlor furniture. It worked fine. So, don't let the grease rag get dirty. It is easy to set the wiping rag down in a spot that's not too clean. The grease and oil on the rag will pick up dirt. Then the next time the rag is used to clean a grease nipple, a little piece of sand slips into the orifice. The new grease pushes the sand particle into the bearing. The particle gets under a ball and dents the raceway. The raceway becomes overstressed and a fatigue crack begins to form. Then we have a bearing failure with serious results.

Like the old story of the horseshoe nail that caused the loss of a battle, a dirty grease rag can have the same result. Grandma had the right idea. She kept the dust rag in a clean coffee can where it wouldn't get dirty. Use a clean rag for a wiper. If you must put it down with grease on it, be careful. KEEP IT CLEAN.

—*USAF "Aerospace Maintenance Safety"*

T56 Engine Summary

In the fore part of this issue, you probably learned some interesting facts about how and why the turboprop engine works.

If you missed it and are unacquainted with this type of engine it is suggested you read "So You Are Switching to Turboprops," beginning on page one.

Now, should you be already operating turboprops you'll more than likely be interested in this howgozit report covering the operation of the T56.

This summary covers fiscal years 1964 and 1965 and includes the T56A-10 and T56A-7 which power the P-3A and C-130 respectively. Because of the limited number of E-2 and C-2 model aircraft and lack of sufficient reports, their history is not included.

Right off the top, indications are that these engines are performing exceptionally well—3000 hours MOT (maximum operating time) between overhaul and consideration is now being given to extension of MOT to 4000 hours after certain engine mods are incorporated. However, let's highlight some of the problem areas which may forearm and forewarn present as well as future operators.

P-3A (T56A-10)

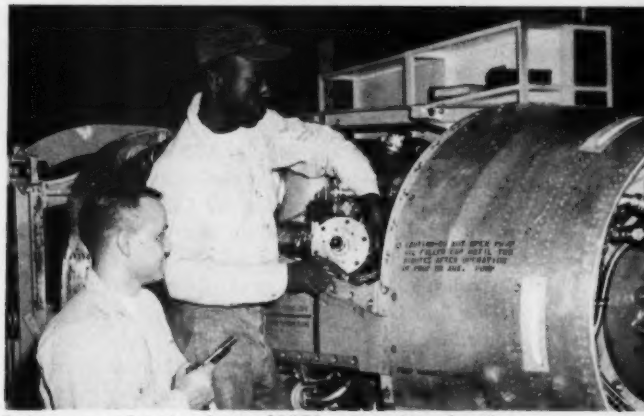
A total of 148,686 flight hours were accumulated by the P-3A during the two-year period resulting in 174 power-plant-involved mishap reports. Of these, 91 involved the basic engine and 77 involved the propeller or related component.

The most significant statistic in basic engine reports were 43 chip detector warning lights. Postflight investigation revealed 14 instances in which replacement of either the engine or reduction gear box was necessary. Though nobody likes false warnings, on the whole they do a fine job.

Next is the sulfidation of Inco 713 first stage turbine blades—27 engines were removed prematurely for this reason in the last three months. Corrective action at the present time is to coat the blades with diffused aluminum called "Alpack" during manufacture of the blades. Serviceable used blades will also be coated during overhaul. Because of limited experience in combating sulfidation only time will tell whether this is the ultimate fix in fleet aircraft.

Propellers: Of 77 reports, 31 or 40 percent were

Turboprops in Antarctica—Engines are much superior to recips in cold weather ops.



Turboprop quick-engine-change (QEC) units reduce downtime for engine/accessory maintenance to a minimum.

low oil warning lights. Seal leakage was reported to be the predominant cause factor. However, it is suspected that improper servicing contributed its share to the relatively high number of low oil warnings. Strict adherence to procedures outlined in the Maintenance Manual will preclude false readings of fluid level. VP-19 submitted a tip on easier prop servicing which is shown below.

C-130 (T56-A-7)

During this same period the C-130 accumulated 113,108 flight hours with 70 mishaps being reported which involved the power plant or propeller.

Basic engine components accounted for 36 reports and the propeller 34. Of the 36 engine reports six were flameouts—the cause was determined in only one instance—a broken balance spring in the fuel control. Maintenance errors, FOD, various malfunctions—mostly one of a kind, accounted for the remainder of the engine reports. No pattern or trend could be established. It is significant that sulphidation of the Inco 713 first stage turbine blades is not a problem in this engine. This situation is attributed to the differences in climatic and operational environments compared to the P-3A.

Chip detector warning lights were reported only

Turboprop Servicing

Situation: The height and forward overhang of the Allison T-56 turboprop engine on the P-3A (*Orion*) provided difficult access during daily maintenance preflight checks. The inaccessability is acute in servicing the prop-fluid reservoir. Because prop-fluid is available only in five-gallon cans and once opened and not entirely used, the fluid was subject to contamination, spillage, and waste.

Fix: A brake bleeder unit, photo left, was adapted to store, transport and pump the fluid (Mil-H-6083b). The fluid is now easily transported, kept uncontaminated, and pumped from the deck, a distance of about 12 ft., into the filler neck.

—CDR D. Howard, CO, VP-19

on two occasions. Both involved ski-equipped LC-130s which are so instrumented. Of the two warning light reports, one resulted in an engine change. The KC-130 used by the Marines is not equipped with chip detector lights. In the KC series, sumps are checked by the continuity method during periodic checks. There were three engine/gear box changes. The difference in the number of engine/gear box changes—14 for the P-3A and 4 for the C-130 series—is attributed mainly to the difference in missions and engine operating procedures.

Propellers. Fluid leakage of the seal was the major factor in the 34 reports. Improper servicing also contributed its share.

In summary, most of the power plant and gear box failures stemmed from material failure factors in both models of the T56. Propeller system failures or malfunctions were largely due to material failures (seal leakage) and improper servicing. Disassembly Inspection Reports (DIRs) indicate most of the engine/gear box failures occurred at relatively high times of 1800 hours and upwards. A pattern for prop failures/malfunctions cannot be established from the reports.

Maintenance errors contributed to 13 percent of all the reported mishaps. While a fix appears to be shaping up for engine/gear box failure by retrofitting —14 and —16 engines (see box), the only fix in sight for the propeller problem is conscientious maintenance and servicing of the propeller system. If this type of maintenance is extended to all of the power plant systems the number of maintenance error mishaps can be held in check. While we're on the subject, we cite this incident as one type we'd like to do without:

During climbout at 150 ft after a touch-and-go, a 900 hp loss was experienced on no. 1 engine. Following an otherwise uneventful landing, investigation revealed a screwdriver blade in the compressor behind the first stage with multiple blade and stator damage.

Keep in mind that while the turboprops are not as susceptible to picking up FOD as some jet engines, they won't repel tools left in the intakes.

Turbojet inspection for Foreign Objects.

-14 and -16 Engines

NEW production P-3As will be powered by the new T56-A-14 engine. It is essentially identical to and interchangeable with -10W engine except for integrally cast mounting pads on the gear box, a revised turbine section and revised external shrouding of the combustion section. Retrofit is planned which will result in complete engine commonality throughout the P-3A fleet.

A-16 engines, embodying similar modifications will be retrofitted to some C-130 series aircraft.

The new engines will provide the following operational advantages:

- Improved flight safety
- Increased rate of climb
- Shorter takeoff distance
- Eliminates water alcohol system
- Increased maximum cruise speed
- Higher cruise ceiling

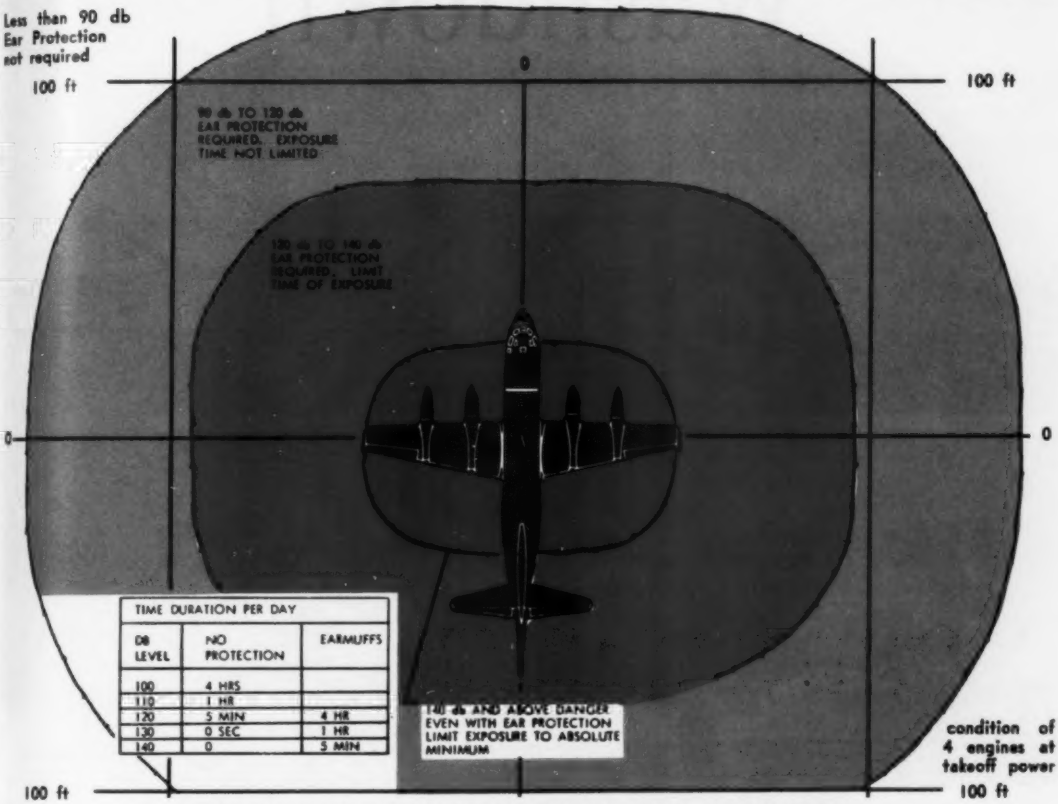
Increased engine performance is obtained by application of an air-cooled turbine. Air-cooled blades operate at temperatures some 200° hotter than uncooled blades. Shaft horsepower is increased from 3755 to 4368 (Military).

Correction Notice Murphy's Law C-130

LAST month's issue (p-45) reported a Murphy situation in the C-130 which permitted cross-connection of electrical leads to the fire bottle squib. It was also reported that BuWeps was investigating a test using an ohmmeter to determine positive and negative connections of the squib. OP 2606 prohibits this type of test to check cartridges.

Since last month's report, BuWeps states that a change (ECP) has been developed consisting of removing and discarding a stainless steel plug which is screwed and safetied into the fire extinguisher head. In its place is installed a similar plug having a ¼ x 20 stud with nuts and washers to accept the ground wire with ¼″ lugs attached. This will preclude installing the power lead and ground lead in reverse, because the power lead with a small lug attached will not fit the ¼″ ground stud.

NOTES AND COMMENTS ON MAINTENANCE



TIME DURATION PER DAY		
DB LEVEL	NO PROTECTION	EARMUFFS
100	4 HRS	
110	1 HR	
120	5 MIN	4 HR
130	0 SEC	1 HR
140	0	5 MIN

INTEGRAL START SYSTEM OPERATION REQUIRES EAR PROTECTION WITHIN 140 db AREA

Huh?? What Did He Say???

THE Deltic equipped version of the P-3A, has the ISS (Integral Start System) which is a very definite physical hazard. Both ground and flight crews transitioning or switching to this new breed of cat must be alerted to the high probability of permanent hearing loss that *will* result if proper protection is not provided and utilized by all concerned. The "stay-time," even though the individual is protected by either rubber ear plugs or Mickey Mouse headsets, is surprisingly of short duration in close proximity to the screaming demon. As the chart depicts, repetitive, prolonged exposure to 140 db noise level *will* result in permanent hearing loss. The insidiousness of this real danger is that the average man will, in the absence of reminders expose himself repeatedly and fail to understand that his hearing is going *before* it is in fact gone!!! In short, prepare now for the ISS by: Properly indoctrinating and outfitting personnel concerned and demanding strict adherence to the use of these safety devices when working in or around the Deltic.

—VP-10

Opening the Hatch

ON P-3 aircraft, pressurization leaks will result if proper care is not given to the hatch seals on the Main Cabin entry and the two wing access hatches. Further, there is a Murphy type possibility that the wing access hatches may be installed on the wrong side (and hence upside down), where the seals will not fit as snugly as on the proper side.

—VP-10

Washdown

'Seaplane' Treatment

When temperature permits, VP-10's P-3As get fresh water bath after flight to reduce corrosion. The homemade wash rack costing less than $200 is made of drilled 2 ½-inch pipe connected to a hydrant and features a bridge to permit easy LG wheel roll-over during taxi-through.—*NAS Brunswick*

ed to a
easy LG
Brunswic

Need A Wrench?

WELL--take your choice! Do you want a crescent wrench, pipe wrench, monkey wrench, pipe strap wrench or chain pipe wrench? Or maybe an open end wrench, box wrench, socket wrench, V-mouth wrench, set screw wrench, spanner wrench, stud wrench or torque wrench? And if that's not good enough how about a pipe and nut combination wrench, flare nut wrench, multisocket wrench or a handle drive socket wrench?

A big selection—you bet! But the question is, do you know how to use any of them without "skinning" your knuckles, or exposing yourself to other injuries? Maybe these few hints will help.

- Adjustable wrenches should be positioned on the nut or bolt so that the pulling force is applied to the stationary jaw section.
- When using a pipe wrench, set it so the teeth will grip the round object with the center of the jaws. This will help prevent the wrench from slipping.
- Adjustable wrenches are not intended to take the place of fixed jaw wrenches. They are principally used to loosen or tighten odd-sized nuts or bolts. Always tighten the adjusting knurl so the wrench fits snugly.
- Select the proper type and size wrench for the job to be done. Make sure the wrench handle and your hands are free from oil or grease.
- Use wrenches that are in top notch condition only. Using defective wrenches can cause skinned knuckles, strains, and other serious injuries from falls.
- When you need a hammer, use a hammer—not a wrench. Using a wrench as a hammer damages it and could cause an accident.
- Place the wrench on the nut so that it fits snugly and in such a position that you will have to pull the wrench and not push it to accomplish the job. Pushing a wrench increases slippage which can result in skinned knuckles and strains.
- Get good solid footing before applying a wrench so that slippage, or bolt and thread breakage, won't throw you off balance.

The Rudders Were Lost For Want of a Nut

A CH-37C on deployment in the Caribbean was making an approach to land on the USS GUADALCANAL when it suffered complete loss of rudder control. The aircraft was 30 ft above the deck edge at 20 kts when the nose yawed violently to the right and the rudder pedals on both sides of the cockpit flopped uselessly back and forth. A waveoff was initiated and the aircraft was climbed to 1000 ft using various combinations of power and cyclic stick to attain the desired headings. The nearest landing field was only three miles away and the pilot proceeded to the field with the intention of making a full autorotation. He orbited the field while the crew chief inspected the rudder controls. He found that the rudder adjuster assembly which provides a pivot point for both sets of rudders had come apart. He held the assembly in place by hand while the pilot made some experimental turns and found that he could control the rudders in this manner. A landing was then made on the airfield without incident.

An inspection revealed that the adjuster assembly, which is suspended from a bracket by a single attaching bolt had dropped out due to the self locking nut backing off. It was further determined that two washers were used under the lock nut instead of one. This prevented a sufficient amount (1 full thread) of the bolt from extending through the self-locking nut to engage the nylon locking feature.

MECH '65

THE Quarterly Report of Maintenance Goofs for the fourth quarter of fiscal '65 normally published in this issue does not appear on these pages because of the coincident publication of MECH 65 during January 1966. The annual is a compilation of maintenance and servicing errors occurring during the fiscal year and is currently being distributed.

Additional copies may be obtained by writing Commander, U. S. Naval Aviation Safety Center, Attn: Safety Education Department, Norfolk, Va. 23511.

It's a Matter of Degree

Did you know that ice at 30° is twice as slippery as ice at 0°?

—National Safety Council

Inventory of Available Tools for Accident Prevention

- Continuous professional attitude
- Meticulous briefings
- Rigid compliance with NATOPS
- Strict adherence to standardized syllab
- Quality workmanship in maintenance

—CHAVANTR

Check Those Spark Plug Gaskets

AN SP-5B was returning to base because of lowe power indications on the left engine. When leveling off after descent, the left engine commenced afte firing and began to evidence visual engine roughnes The engine was feathered and the aircraft was lande without further incident.

Post-flight inspection revealed 70 percent of th spark plugs partially backed off. The copper gaske did not have .0015 and .002 inch indentation pre installed with 360 in. lbs. of torque as prescribed i GPPB-3 and GEB-137. Each gasket was receive packaged individually with the spark plug in a seale plastic bag. Gaskets were too hard and could not mee bending or indentation criteria promulgated in GPPB-3 for use when installing used spark plugs. Investiga tion revealed that none of the uninstalled gasket packaged with AC-283 spark plugs met bendin requirements. All spark plugs were reinstalled usin replacement copper gasket, PN MS17840-1, whic met GPPB-3 criteria.

—VP-5

Oil Servicing

DO not use cadmium-plated tools to open oil can A copter pilot recently had to cancel a flight becaus the chip detector light came ON. A small flake, identi fied as a piece of cadmium-plating, was found on th detector, and further investigation revealed that oi cans were being opened with cadmium-plated scre drivers. The contents of one can were screened an three cadmium flakes were found.

—FSF I

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MURPHY'S LAW *

* If an aircraft part can be installed incorrectly, someone will install it that way!

T56-A-10W Murphy

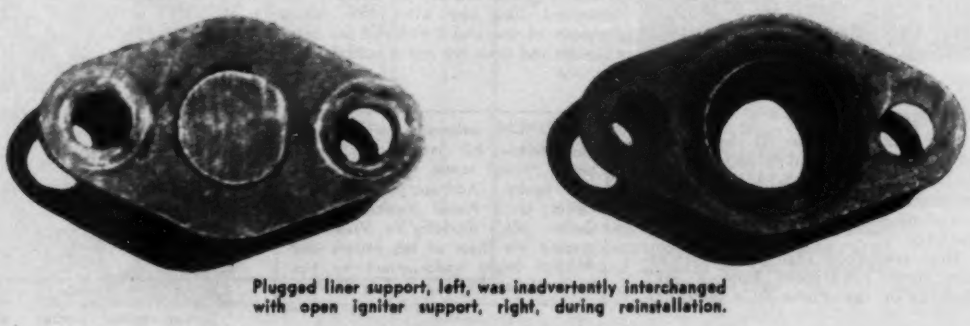
During a routine P-3A calendar Inspection, two igniter supports (Support, Assembiy, Liner) and four dummy supports (Support, Liner Burner Position) were removed to permit boroscoping of the engine.

An igniter support was reinstalled in place of a dummy support. These parts are identical in size, shape and mounting characteristics. The only difference being that the dummy support is of a *solid construction* whereas the igniter support has a center hole in which the igniter plug is mounted. See photos below.

No malfunction was observed during ground turn-up. The engine was mechanically feathered and restarted in flight in accordance with standard test flight doctrine. Again, no malfunction was observed. When the engine was shut down upon completion of the test flight smoke was noticed emitting from the nacelle. An investigation revealed the Murphy which was allowing an opening to the atmosphere.

On engine shutdown hot exhaust gasses escaped through a drain tube, scoring two bends in the pipe. Scorched deposits and smoke residue accumulated between the burner basket liner and the insulating shield, and the area from the firewall aft to the tail pipe heat shield shroud was covered with smoke residue.

—CDR D. Howard, CO VP-19



Plugged liner support, left, was inadvertently interchanged with open igniter support, right, during reinstallation.

LETTERS

Want your safety suggestion read by nearly a quarter of a million people in naval aviation? Send your constructive suggestions to APPROACH.

Photo 1

Photo 2

Navigator Stand

FPO San Francisco—At the present time no ladder or stand exists for use by the navigator in the P-3A when using the sextant. It has been common practice to use the seat at that station as a platform.

Here are photos that show a navigation stand constructed from a Mk2 Mod O PDC can. Photo No. 1 shows the long side for use by a short navigator and photo No. 2 shows the short side.

The stand can be placed in the head or lashed to the deck when not in use.

BILL R. BROYLES, LT
ASO, VP-28

• Secure stowage of the stand when not in use might present a problem. Otherwise it looks good from here.

Flight Suit on Top

Washington, D. C.—Now that poopy suit weather is upon us I would like your opinion regarding the wearing of flight suits over poopy suits.

We E-1B, EA-1F, S-2 types are much exposed to the anti-exposure suit hazards of dirt, grease, oil, lock wires, survival knives, dzus keys, can openers, pencils, pens and other rubber penetrating paraphernalia; and as a result walk around in anti-exposure suits that occasionally resemble patchwork quilts, much to the consternation of the AvQuip Officer.

While attached to VAW-12, some of us wore larger size flight suits over our anti-exposure suits which allowed the easy carrying of our "goodies" and survival equipment plus giving excellent protection against the deteriorating effects of grease and oil. My Mark V was returned like new after two winter seasons of use and I enjoyed the benefits derived from the extra pocket space without incurring any additional discomfort from the extra clothing.

JOSEPH R. EGAN, LT
NAVCOSSACT

• We concur heartily with your idea. Two squadrons have done this for a year and report a total of only four suit repairs, all to the neck zippers.

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

Shroud Cutter

FPO, New York—Some of us had a discussion recently in AirLant as to the use of the survival knife (modified) as a parachute shroud cutter in lieu of the standard issue parachute shroud cutter (the latter, we endorse whole-heartedly). Therefore, we submit the following information:

During transition from F-8's to F-4's at NAS Key West, under the tutelage of VF-101, VF-33 picked up, in addition to flight and ground training, a valuable idea for its survival program. VF-101's parachute riggers had devised an installation for the standard issue parachute shroud cutter, which provides security along with easy and quick accessibility. VF-33 is happy to put out

Shroud cutter pocket below light.

the dope to other squadrons, and pass the credit to VF-101.

J. S. COLEMAN, JR., LT
ASO, VF-33

• **Looks all right to us. We pass it along to our readers.**

Air Moisture vs Engine Thrust

Washington, D. C.—Concerning the "Air Moisture vs. Engine Thrust" article on page 45, October 1965.

Everything said is correct, but the nail was not quite driven home. Thrust augmentation by water/alcohol injection is not just a hot day device. It is a basic thrust increase method, and does more than compensate.

All other things being constant we can get as much as 15-20 percent thrust increase at takeoff. This increase comes about for two reasons:

(a) the mass flow through the engine is increased; and

(b) the thermodynamic effect is to produce a higher tail pipe pressure.

Test indicated that both above items are approximately equal. Let's take an example (from an "old" engine):

At sea level static conditions the engine takes approximately 60 lbs air/fuel. We inject approximately five lbs water/alcohol mix/fuel.

air		fuel		w/a	
60	+	1	+	5	66
60	+	1	+		61

1.08....or 108% thrust $\dfrac{\text{Mass (wet)}}{\text{Mass (dry)}}$

This is part (a). So, since
(a) = (b) ......108+8 = 116%

Check with the maintenance officer or tech rep for the real scoop on your specific engines.

OLD ANYMOUSE
W. V. GOUGH, JR., CAPT, USNR
FEDERAL AVIATION AGENCY

• **You have hit the nail on the head—hope this assists you in driving it home.**

Life Vest Maintenance

FPO New York—Care and preservation of life vests can be a headache for aviation equipment personnel in patrol squadrons. Here is how VP-10 solved the problem of keeping the vests reasonably clean and intact.

Photo 1 shows a vest being checked out at the AvEquip shop (conveniently located on the hangar deck) prior to a flight.

Upon return (photo 2) the vests are placed in a large receptacle adjacent to the checkout point. They are later retrieved by shop personnel, inspected and then returned to the racks, ready for reissue.

This system has dropped our life vest loss-rejection rate by 95 percent.

J. B. MCDANIEL, LCDR
ASO, VP-10

• **Sounds good.**

Check out.

Check in.

"Difference" is in electrical connectors (circled).

Another Hazard in 'Six Differences'

NAS North Island—Upon inspection of the cartoons (Six Differences) page 43 of the November '65 issue, I find a major hazard which was overlooked by your staff.

I call your attention to the electrical outlet and drill plug-in, both of which clearly indicate the lack of a ground conductor. U. S. Navy Safety Precautions, OpNav 34P1, article 18203 (*being rewritten—Ed.*) requires all electrical tools and electrical wall outlets to have three conductors, one which is a positive ground.

L. MICHALSKI, LT
FAETUPAC

USCGAS Biloxi, Miss. (A similar comment was received from the following—*Ed.*):

J. R. BUTLER, LCDR

• **Good eye, sirs. A keen observation and real sound advice. Shame on us—seems our periscopes were 180 and focused on the beaches of Aloha land at the time.**

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Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

Contents

DEPARTMENTS

NavWeps 00-75-510

CREDITS

Cover painting of the T56 in a P-3A engine nacelle, courtesy Allison Division, GMC, Indianapolis, Ind.

IFC photos 2, 3 (from top) and page 5 courtesy Grumman Aircraft Co., Bethpage, L. I., photo 4 (from top) courtesy North American Aviation, Columbus, Ohio.

Page 3 photo courtesy Douglas Aircraft Co., Long Beach, Calif.

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The Fresh Approach

A man, standing on a lurching subway, noticed there was nothing to hang on to. Others also noticed—and grasped the opportunity to complain. The man grasped the opportunity to produce—he developed the leather strap that is now a familiar sight in subways.

A housewife, tired of broken milk bottles on the front porch, thought of the idea of putting milk in cardboard cartons.

A man from Wichita, driving across the country, became lost. He developed the system for marking highways that is used across the nation.

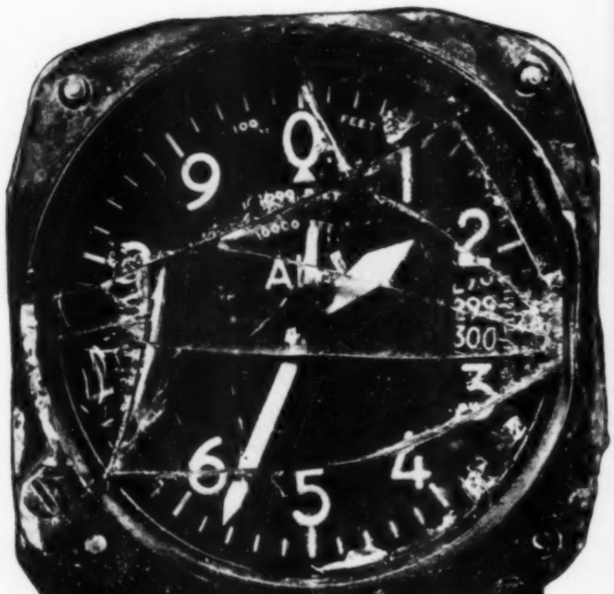
The next time you see something to complain about, take a second look. If you can't change it, accept it. If you can change it, do it.

Every development comes because someone had the ability to do more than complain.

There is always something around that can trigger the creative imagination of those who take the "fresh approach."

The Beechcrafter

Contributed by VA



COMPLACENCY KILLS